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SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

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19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

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Carlsbad, New Mexico
Alamogordo, New Mexico
Nevada Test Site

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Fallout patterns from U.S. continental nuclear weapons tests. Also given are time and place of test and ambient winds.

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OPERATION TRINITY

	MST	GMT
DATE:	16 Jul 1945	16 Jul 1945
TIME:	0529	1229

TOTAL YIELD: 19 kt

FIREBALL DATA:

Time to 1st minimum:	NM
Time to 2nd maximum:	NM
Radius at 2nd maximum:	NM

Sponsor: LASL

SITE: 57 miles Northwest of Alamogordo, New Mexico
Coordinates: 33° 40' 31" N
106° 28' 29" W
Site elevation: 4,624 ft

HEIGHT OF BURST: 100 ft

TYPE OF BURST AND PLACEMENT:
Tower burst

CLOUD TOP HEIGHT: 35,000 ft MSL
CLOUD BOTTOM HEIGHT: 10,600 ft MSL

CRATER DATA: Diameter: 1,100 ft
Depth: 9.5 ft

REMARKS:

Extensive surveys were made four hours after the shot with beta and gamma survey meters. The measurements were adjusted to H+1 hour by using the $t^{-1.2}$ law to approximate the decay.

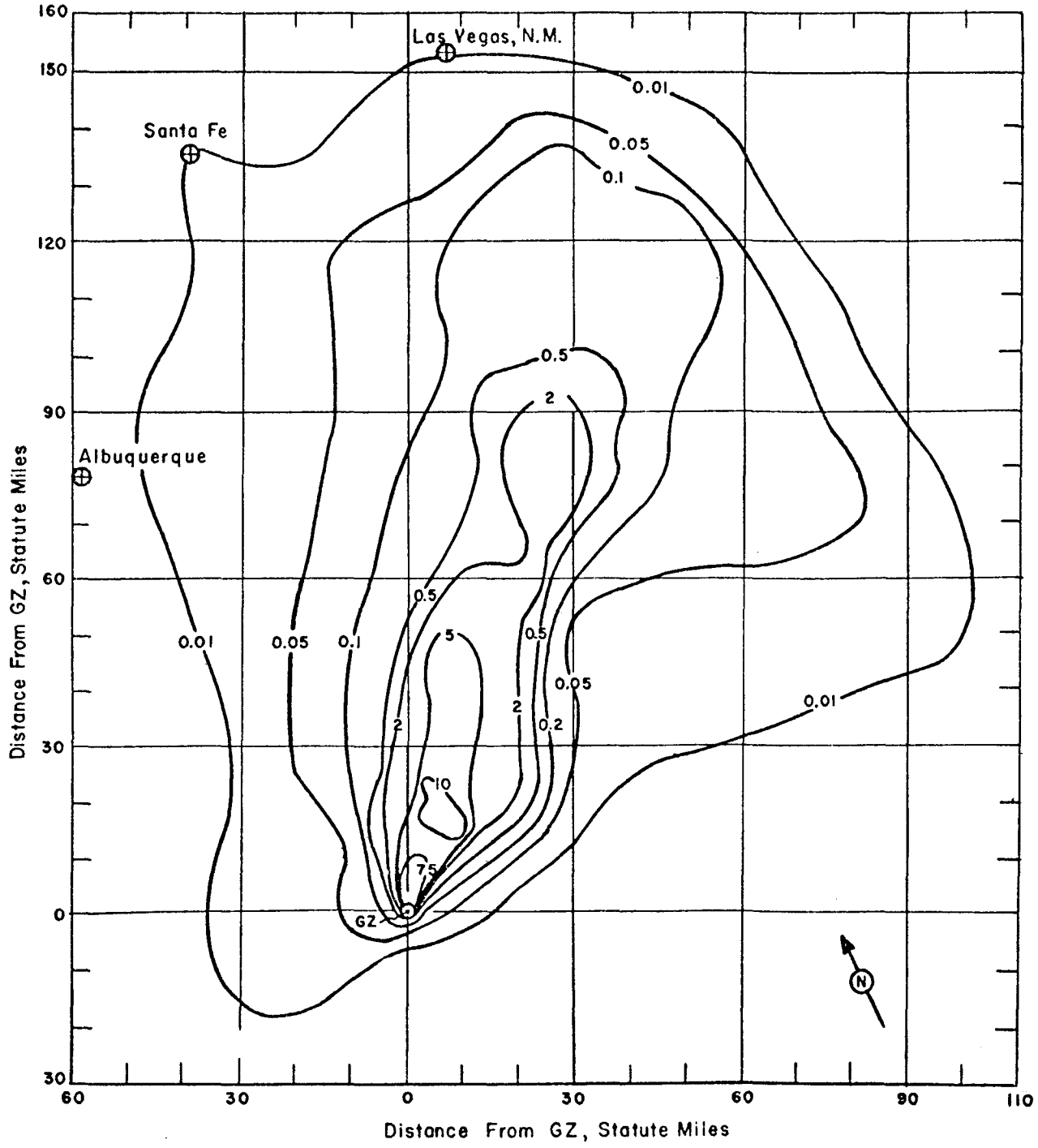

Figure 1. Operation TRINITY off-site dose rate contours in r/hr at H+1 hour.

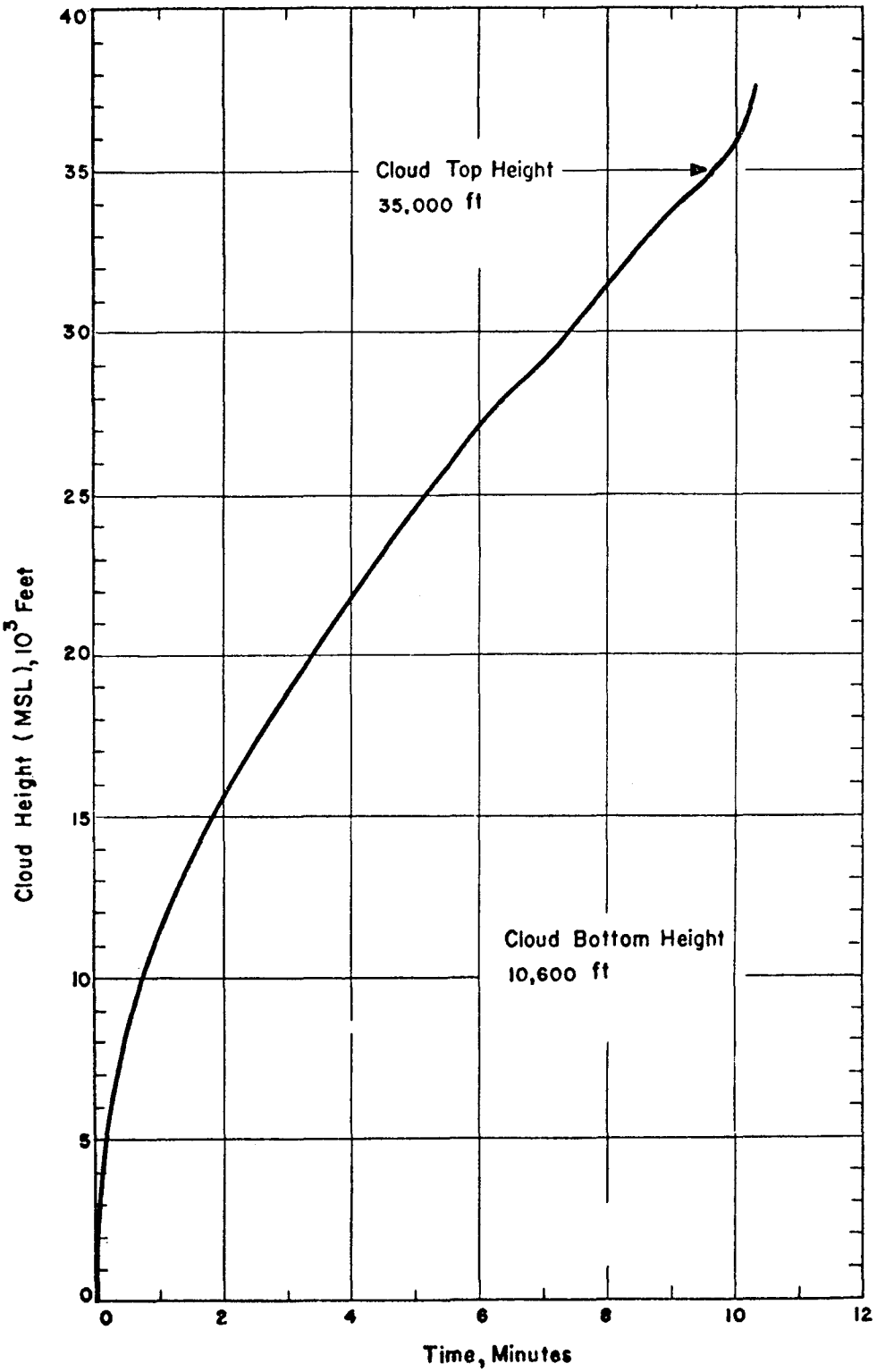

Figure 2. Cloud Dimensions: Operation TRINITY.

TABLE 1 ALAMOGORDO, NEW MEXICO WIND DATA FOR OPERATION TRINITY

Altitude (MSL)	H-hour		H+1½ hours		H+4 hours		H+7 hours		H+10¼ hours	
	Dir	Speed	Dir	Speed	Dir	Speed	Dir	Speed	Dir	Speed
feet	degrees	mph	degrees	mph	degrees	mph	degrees	mph	degrees	mph
5,100	110	04	---	--	---	--	---	--	---	--
5,300	160	07	330	04	160	03	240	01	140	09
6,000	200	06	260	03	150	03	120	02	100	04
6,700	230	07	230	04	140	03	140	05	100	03
7,300	250	08	250	04	160	03	130	07	140	05
7,900	250	10	270	03	160	05	130	07	150	07
8,500	240	08	250	04	150	05	130	06	170	07
9,100	230	07	230	04	170	05	130	08	190	07
9,700	220	08	230	07	190	07	140	10	180	06
10,300	220	12	230	10	210	10	150	10	170	05
10,900	220	11	230	13	200	11	150	08	180	04
11,500	200	08	220	12	180	11	150	05	070	02
12,100	190	07	170	10	170	11	190	03	310	05
12,700	170	09	160	11	180	11	240	03	310	06
13,300	170	12	160	12	190	11	240	04	320	04
13,900	160	12	170	14	210	12	250	06	310	05
14,500	150	13	180	16	200	13	270	08	290	06
15,100	140	13	180	15	180	13	280	10	280	05
15,700	130	16	190	13	170	16	280	08	290	06
16,300	120	16	190	12	170	16	270	05	280	07
16,900	140	12	190	07	190	11	250	04	290	05
17,500	160	10	160	07	210	03	240	05	270	03
17,600	150	13	---	--	---	--	---	--	---	--
18,100	---	--	170	05	320	02	260	05	270	03
18,600	150	12	---	--	---	--	---	--	---	--
18,700	---	--	210	04	280	02	260	06	270	01
19,300	---	--	220	03	270	03	250	06	130	03
19,600	180	04	---	--	---	--	---	--	---	--
19,900	---	--	---	--	270	02	250	06	180	05
20,600	250	04	---	--	---	--	---	--	---	--
21,600	240	08	---	--	---	--	---	--	---	--
21,700	---	--	---	--	---	--	220	11	210	08
22,600	220	11	---	--	---	--	---	--	---	--
22,900	---	--	---	--	---	--	190	17	210	16
23,600	220	15	---	--	---	--	---	--	---	--
24,600	220	15	---	--	---	--	---	--	---	--
29,600	230	16	---	--	---	--	---	--	---	--
34,600	230	27	---	--	---	--	---	--	---	--
39,600	240	19	---	--	---	--	---	--	---	--
44,600	290	18	---	--	---	--	---	--	---	--
48,600	280	11	---	--	---	--	---	--	---	--

Note: At H-hour the surface air pressure was 12.39 psi and the temperature 21.8°C.

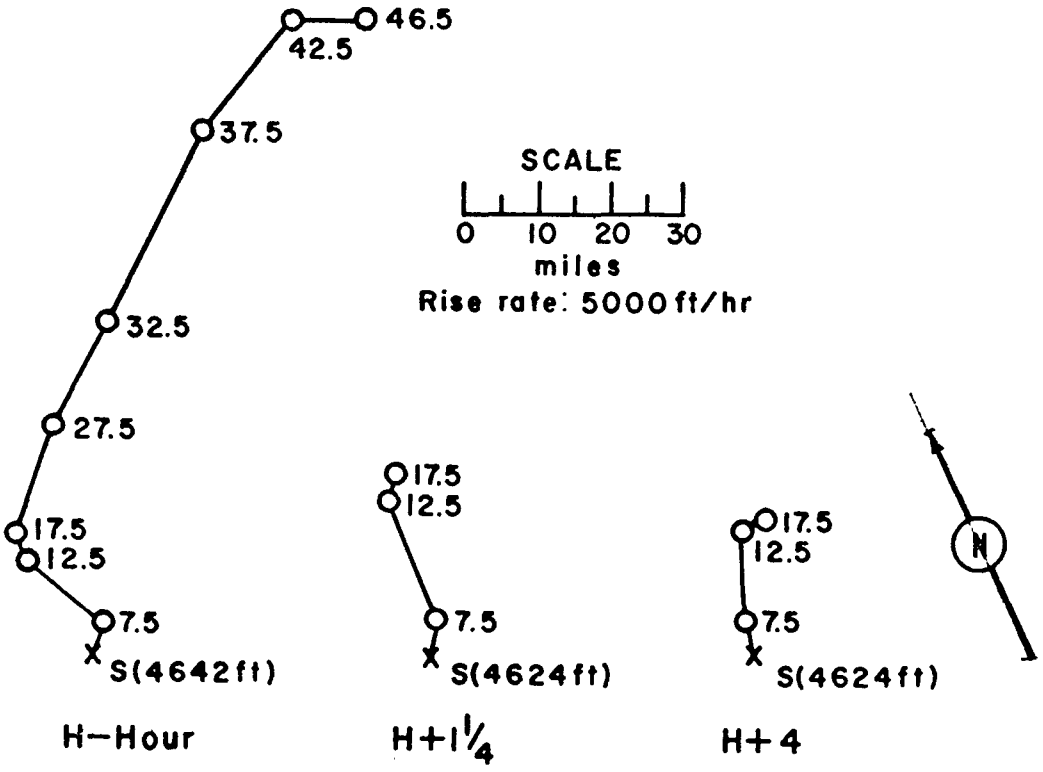

Figure 3. Hodographs for Operation TRINITY

OPERATION BUSTER-JANGLE - Baker

	PST	GCT
DATE:	28 Oct 1951	28 Oct 1951
TIME:	0720	1520

Sponsor: LASL

SITE: NTS - Area 7 - Station 3
37° 05' 06" N
116° 01' 12" W
Site elevation: 4,193 ft

TOTAL YIELD: 3.5 kt

HEIGHT OF BURST: 1,118 ft

CLOUD TOP HEIGHT: 31,700 ft MSL
CLOUD BOTTOM HEIGHT: 23,000 ft MSL

FIREBALL DATA:
Time to 1st minimum: 5.5 to 6.0 msec
Time to 2nd maximum: NM
Radius at 2nd maximum: NM

CRATER DATA: No crater

TYPE OF BURST AND PLACEMENT:
Air burst over Nevada soil

REMARKS:

The contours resulting from this shot were due primarily to neutron-induced activity. Readings were obtained by monitors during area surveys or recovery operations and were taken 3 ft above ground with T1B or SU-10 ionization-chamber survey meters. The pattern was obtained from readings taken at H+11 hours and corrected to H+1 hour, using the decay curve for neutron-induced activity in Nevada soil

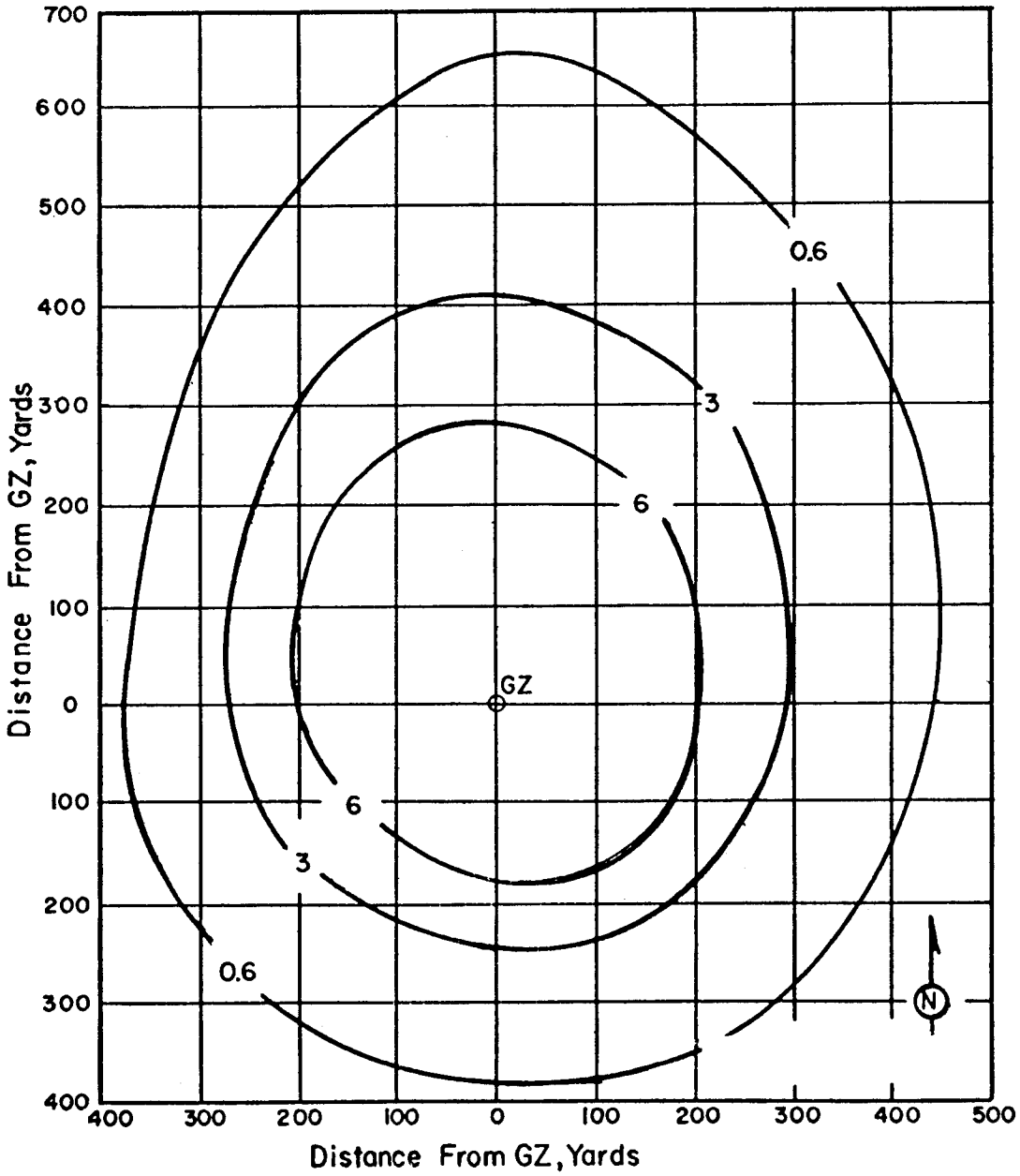

Figure 20. Operation BUSTER-JANGLE - Baker.
On-site dose rate contours in r/hr at H+1 hour.

OPERATION BUSTER-JANGLE - Charlie

	PST	GCT
DATE:	30 Oct 1951	30 Oct 1951
TIME:	0700	1500

TOTAL YIELD: 14 kt

FIREBALL DATA:

Time to 1st minimum:	12.5 to 13.0 msec
Time to 2nd maximum:	130 to 135 msec
Radius at 2nd maximum:	NM

CRATER DATA: No crater

Sponsor: LASL

SITE: NTS - Areas 7 - Station 3
37° 05' 06" N
116° 01' 13" W
Site elevation: 4,193 ft

HEIGHT OF BURST: 1,132 ft

TYPE OF BURST AND PLACEMENT:
Air burst over Nevada soil

CLOUD TOP HEIGHT: 41,000 ft MSL
CLOUD BOTTOM HEIGHT: 27,000 ft MSL

REMARKS:

The contours resulting from this shot were due primarily to neutron-induced activity. Readings were obtained by monitors during area surveys or recovery operations and were taken 3 ft above ground with T1B or SU-10 ionization-chamber survey meters. The pattern was obtained from readings taken at H+9 hours and corrected to H+1 hour using the decay curve for neutron-induced activity in Nevada soil,

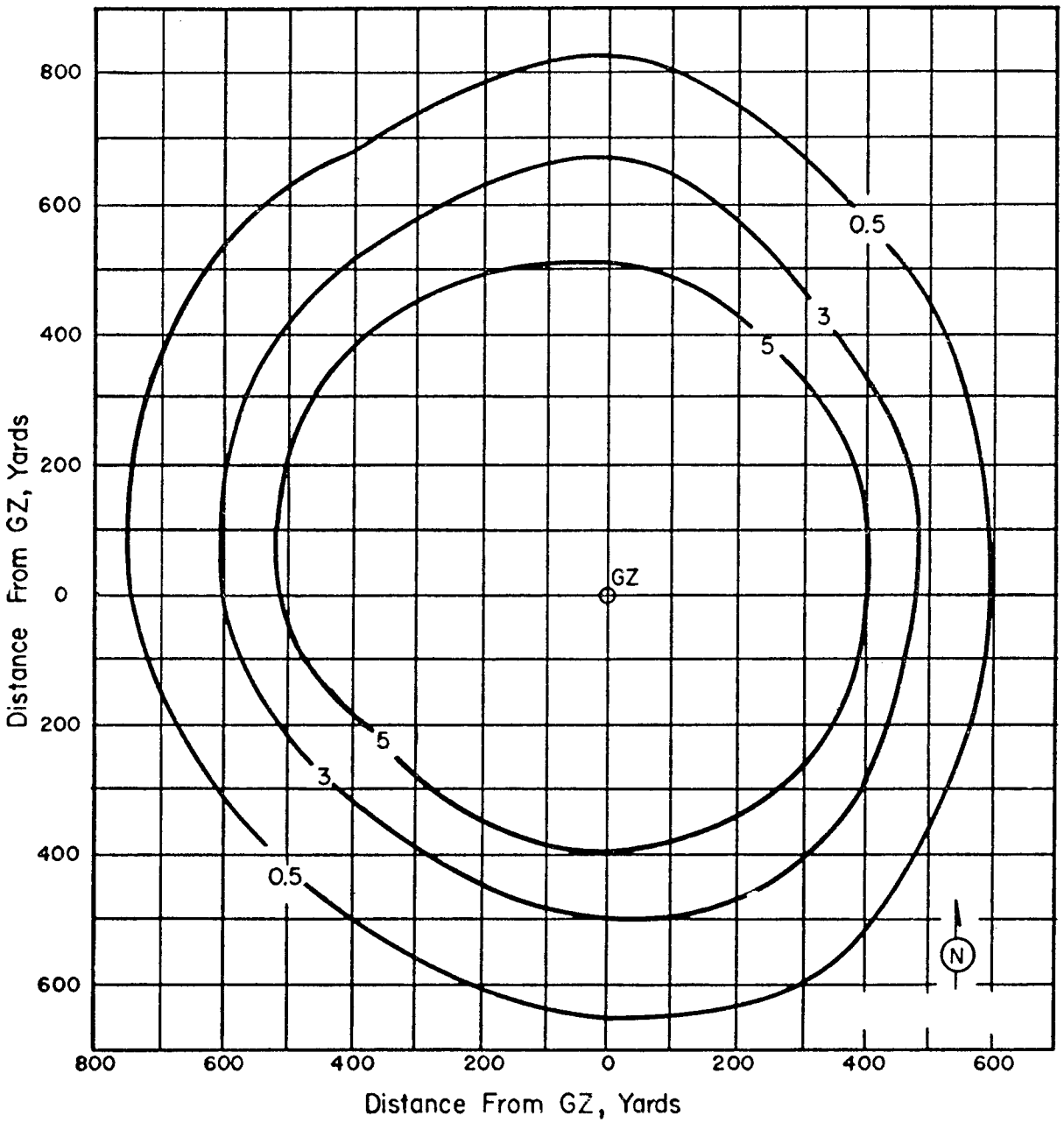

Figure 23. Operation BUSTER-JANGLE - Charlie.
On-site dose rate contours in r/hr at H+1 hour.

OPERATION BUSTER-JANGLE - Dog

	PST	GCT
DATE:	1 Nov 1951	1 Nov 1951
TIME:	0730	1530

Sponsor: LASL

SITE: NTS - Area 7 -
Station 3
37° 05' 05" N
116° 01" 11" W
Site elevation: 4,193 ft

TOTAL YIELD: 21 kt

HEIGHT OF BURST: 1,417 ft

FIREBALL DATA:

Time to 1st minimum:	15.6 msec
Time to 2nd maximum:	160 to 175 msec
Radius at 2nd maximum:	NM

TYPE OF BURST AND PLACEMENT:
Air burst over Nevada soil

CRATER DATA: No crater

CLOUD TOP HEIGHT: 46,000 ft MSL
CLOUD BOTTOM HEIGHT: 31,000 ft MSL

REMARKS:

The contours resulting from this shot were due primarily to neutron-induced activity. Readings were obtained by monitors during area surveys or recovery operations and were taken 3 ft above ground with T1B or SU-10 ionization-chamber survey meters. The pattern was obtained from readings taken at H+25½ hours and corrected to H+1 hour using the decay curve for neutron-induced activity in Nevada soil

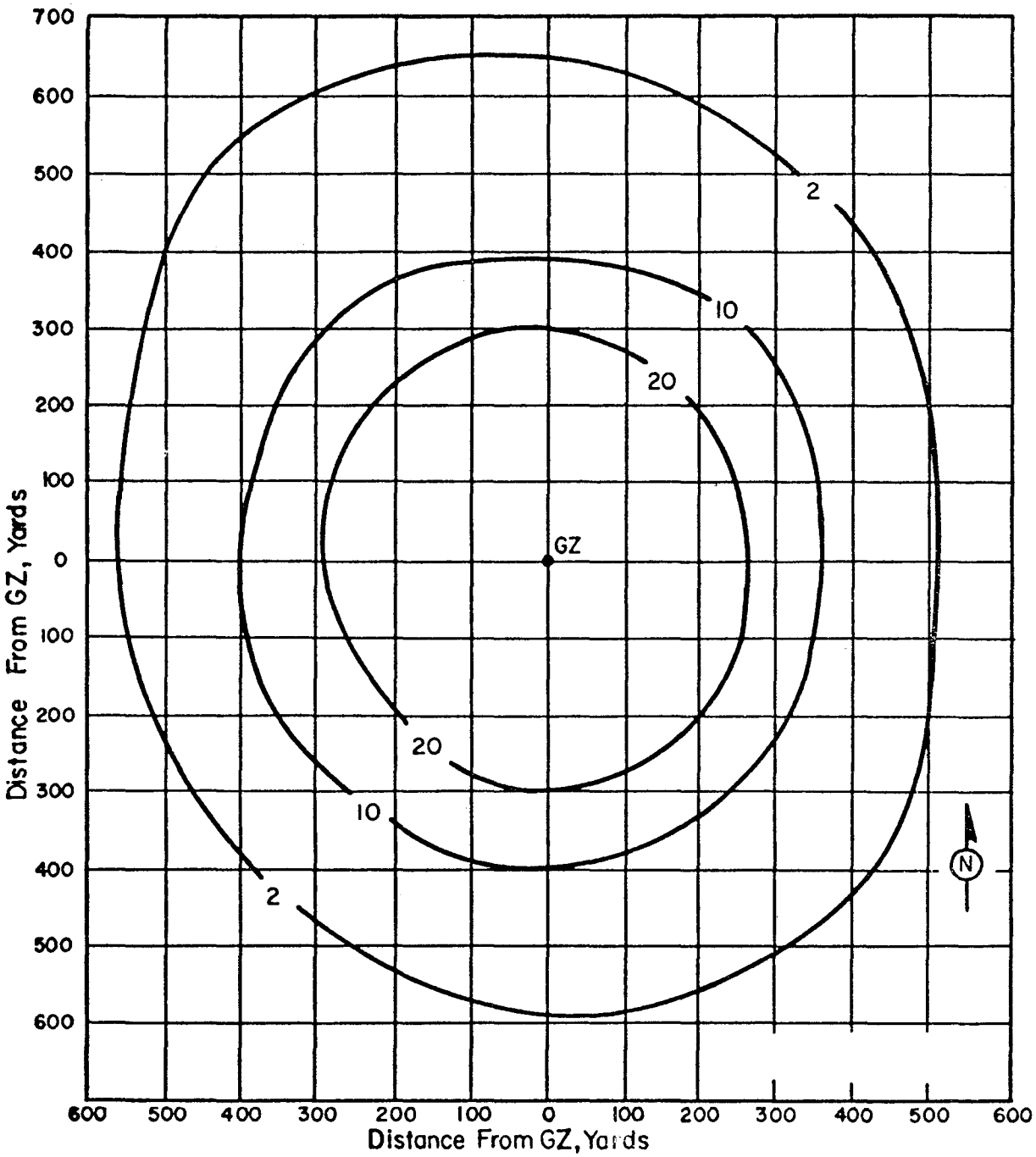

Figure 26. Operation BUSTER-JANGLE - Dog. On-site dose rate contours in r/hr at H+1 hour.

OPERATION BUSTER-JANGLE - Easy

	PST	GCT
DATE:	5 Nov 1951	5 Nov 1951
TIME:	0830	1630

Sponsor: LASL

SITE: NTS - Area 7 - Station 1
37° 05' 31" N
116° 01' 28" W
Site elevation: 4,224 ft

HEIGHT OF BURST: 1,314 ft

TOTAL YIELD: 31.0 kt

TYPE OF BURST AND PLACEMENT:
Air burst over Nevada soil

FIREBALL DATA:

Time to 1st minimum:	15 to 20 msec
Time to 2nd maximum:	190 to 210 msec
Radius at 2nd maximum:	NM

CLOUD TOP HEIGHT: 50,000 ft MSL
CLOUD BOTTOM HEIGHT: 35,000 ft MSL

CRATER DATA: No crater

REMARKS:

The contours resulting from this shot were due primarily to neutron-induced activity. Readings were obtained by monitors during area surveys or recovery operations and were taken 3 ft above ground with T1B or SU-10 ionization chamber survey meters. The pattern was obtained from readings taken at H+24 hours and corrected to H+1 hour, using the decay curve for neutron-induced activity in Nevada soil

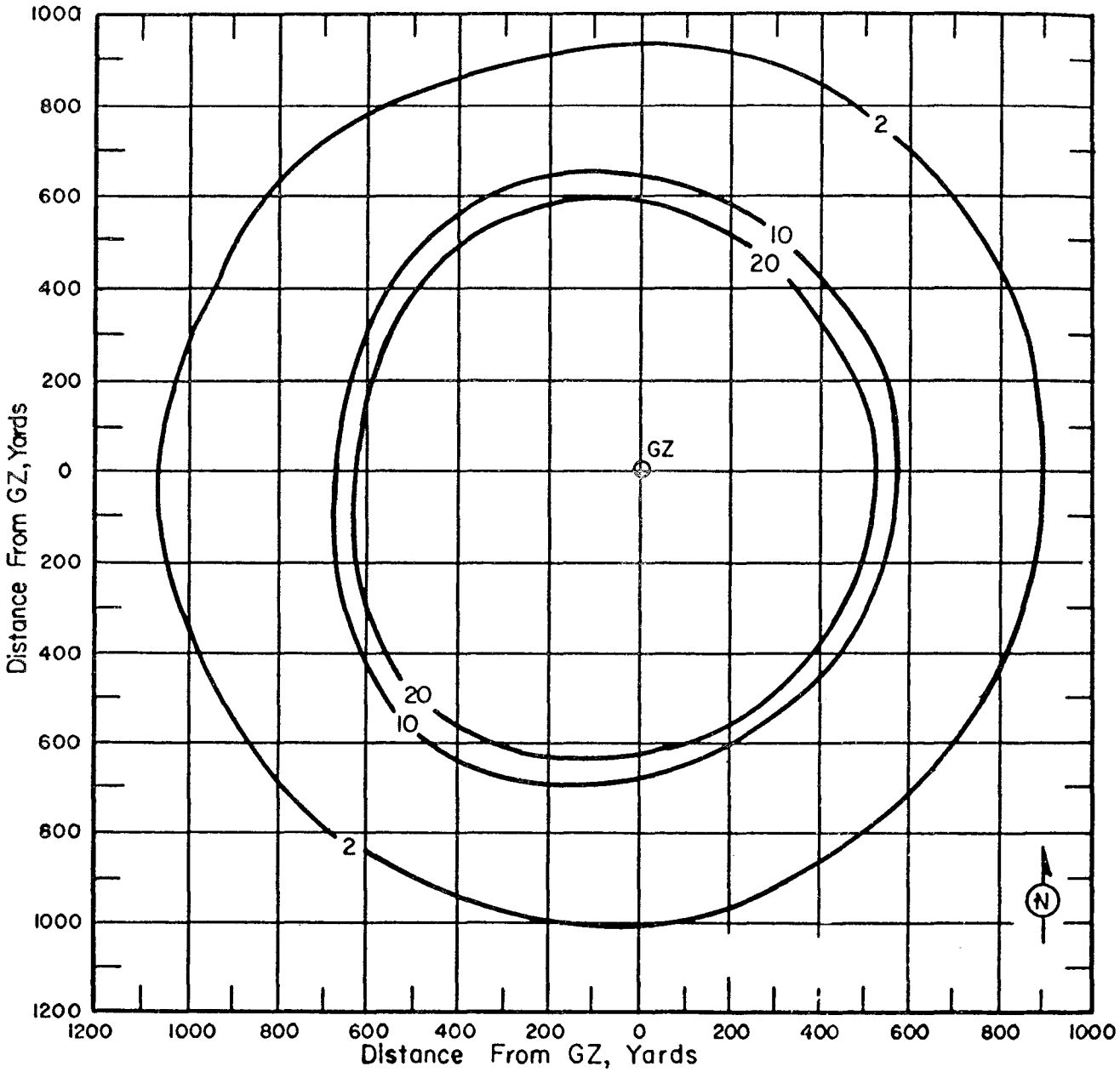

Figure 29. Operation BUSTER-JANGLE - Easy.
On-site dose rate contours in r/hr at H+1 hour.

OPERATION TUMBLER - SNAPPER - EASY

	PST	GMT
DATE:	7 May 1952	7 May 1952
TIME:	0415	1215

Sponsor: LASL

SITE: NTS - Area T-1
37° 03' 11" N
116° 06' 20" W
Site elevation: 4,329.25 ft

TOTAL YIELD: 12 kt

HEIGHT OF BURST: 300 ft

TYPE OF BURST AND PLACEMENT:
Tower burst over Nevada soil

FIREBALL DATA:
Time to 1st minimum: 9.3 to 12.5 msec
Time to 2nd maximum: 95
Radius at 2nd maximum: NM

CLOUD TOP HEIGHT: 34,000 ft MSL
CLOUD BOTTOM HEIGHT: Not available

CRATER DATA: No crater

REMARKS:

The on-site fallout pattern was obtained from readings of radiological survey teams on D+1 day along eight radial lines of numbered stakes 300 feet apart. The stakes within approximately 1200 to 1500 feet of ground zero were destroyed or blown down so that they did not provide adequate reference points. The survey readings were extrapolated to H+1 hour by using the $t^{-1.2}$ decay approximation. The off-site readings were obtained by ground mobile monitors of the Radiological Safety organization on D-day. These readings were extrapolated to H+1 hour by using the $t^{-1.2}$ decay approximation.

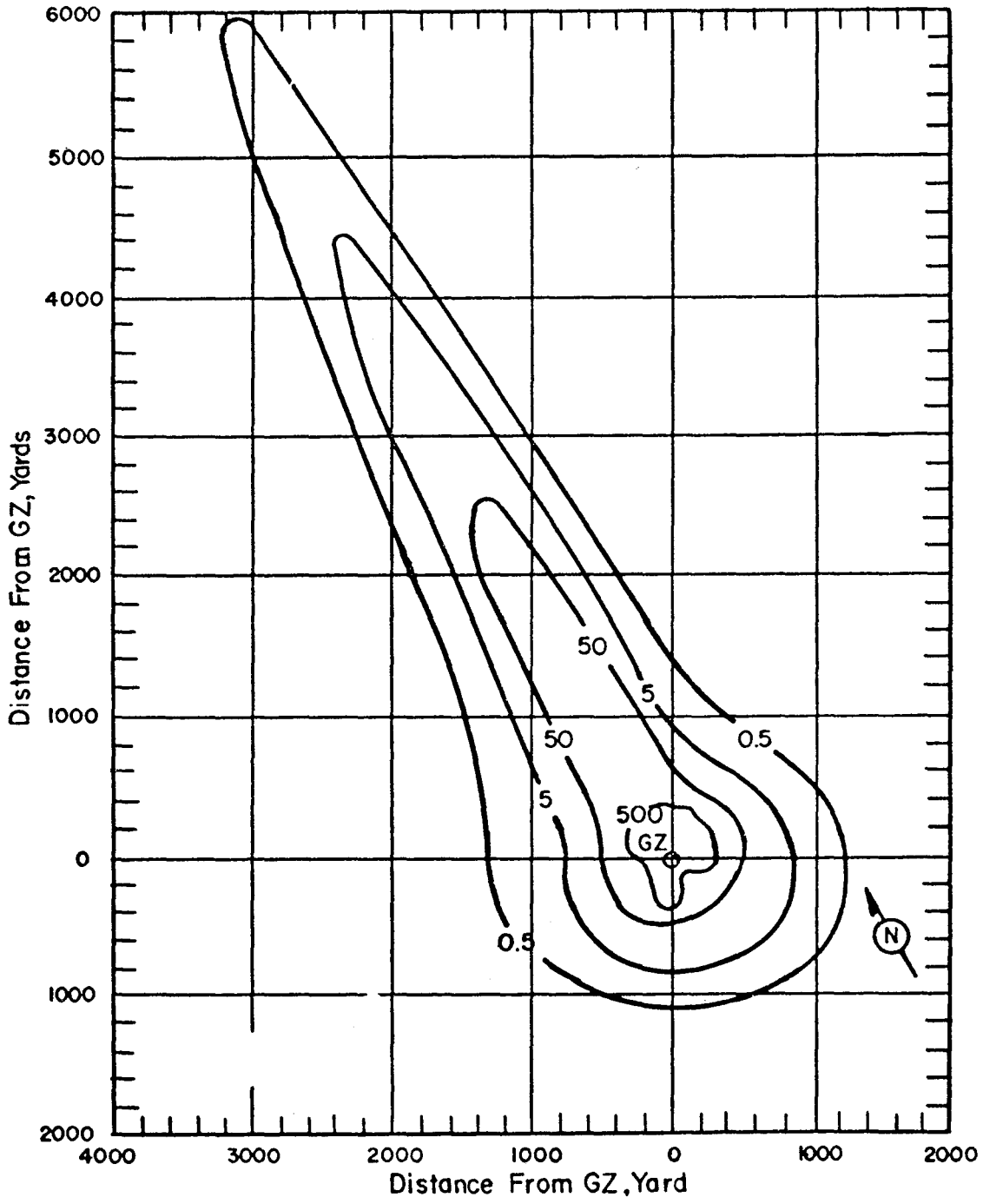

Figure 53. Operation TUMBLER-SNAPPER-EASY. On-site dose rate contours in r/hr at H+1 hour.

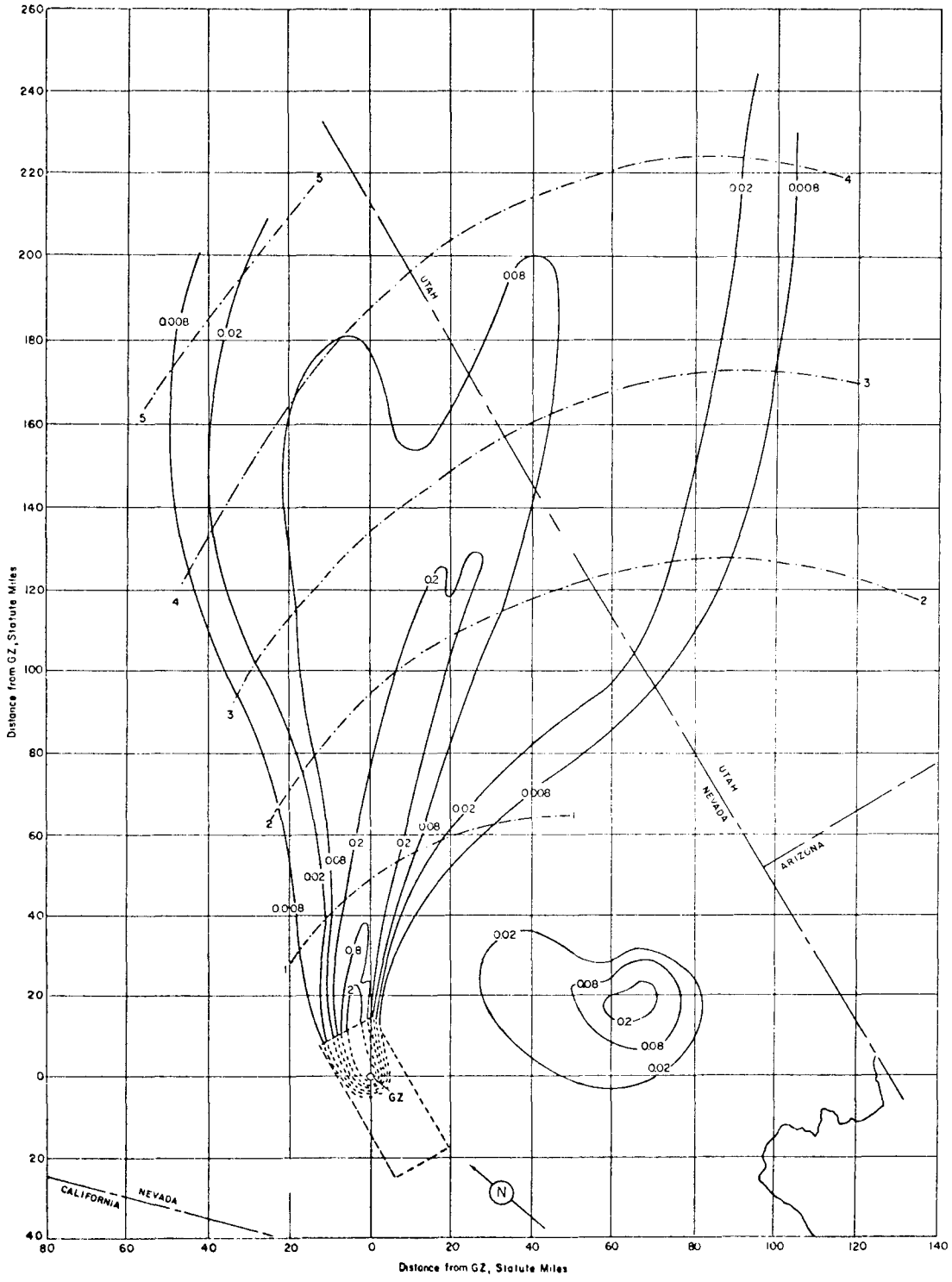

Figure 54. Operation TUMBLER-SNAPPER - EASY Off-site dose rate contours in r/hr at H+1 hour.

TABLE 18 NEVADA WIND DATA FOR OPERATION TUMBLER-SNAPPER- EASY

Altitude (MSL)	H-hour		Altitude (MSL)	H-hour	
	Dir	Speed		Dir	Speed
feet	degrees	mph	feet	degrees	mph
Surface	Calm	Calm	12,000	190	52
4,000	Calm	Calm	14,000	190	62
5,000	Calm	Calm	15,000	190	56
6,000	180	23	16,000	210	55
7,000	180	30	18,000	210	67
8,000	180	37	20,000	220	77
9,000	190	40	25,000	220	90
10,000	180	41	30,000	220	107

NOTES:

1. Wind data was obtained by the Mercury Weather Station located at the C. P.
2. Tropopause height was 41,000 ft MSL.
3. At H-hour the pressure at ground zero was 868 mb, the temperature 60.5°F and the relative humidity 40%.

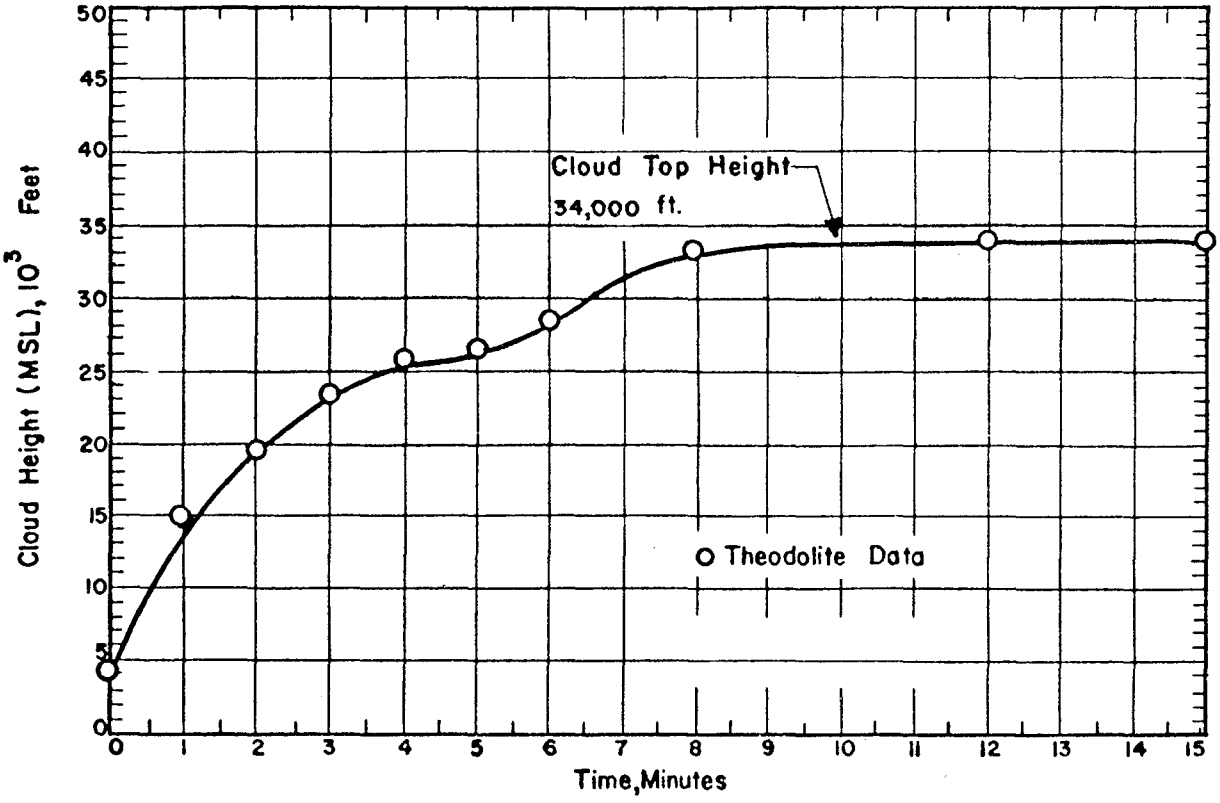

Figure 55. Cloud Dimensions: Operation TUMBLER-SNAPPER-EASY

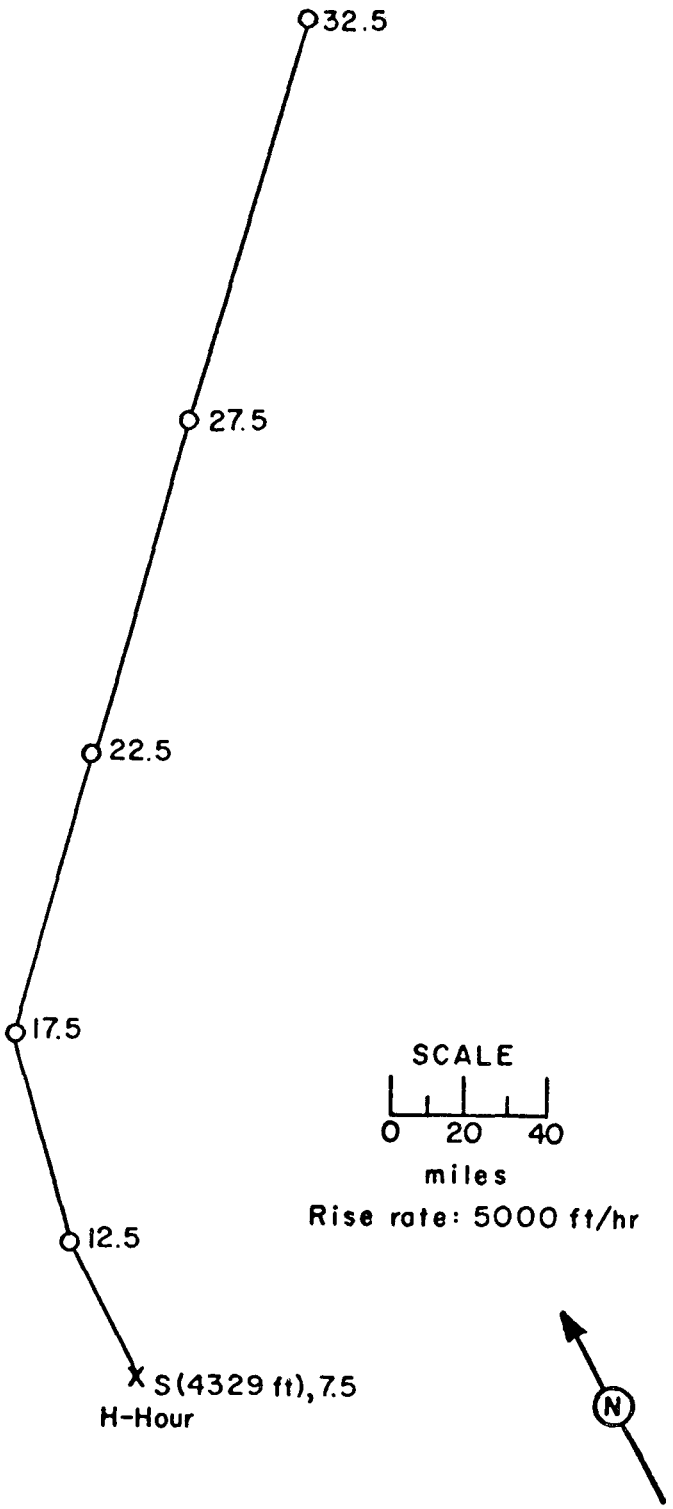

Figure 56. Hodograph for Operation TUMBLER-SNAPPER-EASY

OPERATION UPSHOT-KNOTHOLE - Harry

	PST	GMT
DATE:	19 May 1953	19 May 1953
TIME:	0405	1205

Sponsor: LASL

SITE: NTS - Area 3a
37° 02' 25" N
116° 01' 31" W
Site elevation: 4,006 ft

TOTAL YIELD: 32 kt

HEIGHT OF BURST: 300 ft

FIREBALL DATA:
Time to 1st minimum: 16.8 to 19.2 msec
Time to 2nd maximum: 155 msec
Radius at 2nd maximum: NM

TYPE OF BURST AND PLACEMENT:
Tower burst over Nevada soil

CLOUD TOP HEIGHT: 42,500 ft MSL
CLOUD BOTTOM HEIGHT: 27,500 ft MSL

CRATER DATA: No crater

REMARKS:

The on-site fallout pattern was obtained from readings at H+1 hour. No decay corrections were necessary. The off-site fallout pattern was drawn from D-day readings of mobile ground-survey teams of the Radiological Safety organization. This shot is sometimes designated as Upshot-Knothole-Shot 8.

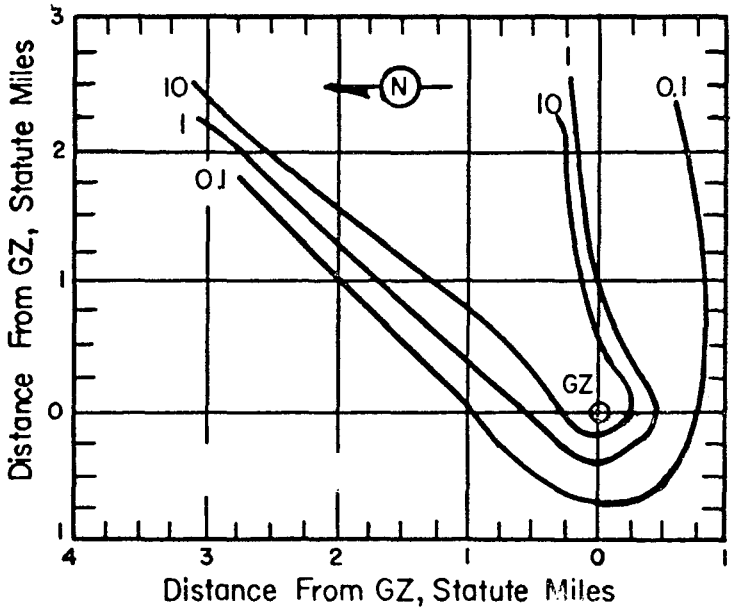

Figure 99. Operation UPSHOT-KNOTHOLE - Harry.
On-site dose rate contours in r/hr at H+1 hour.

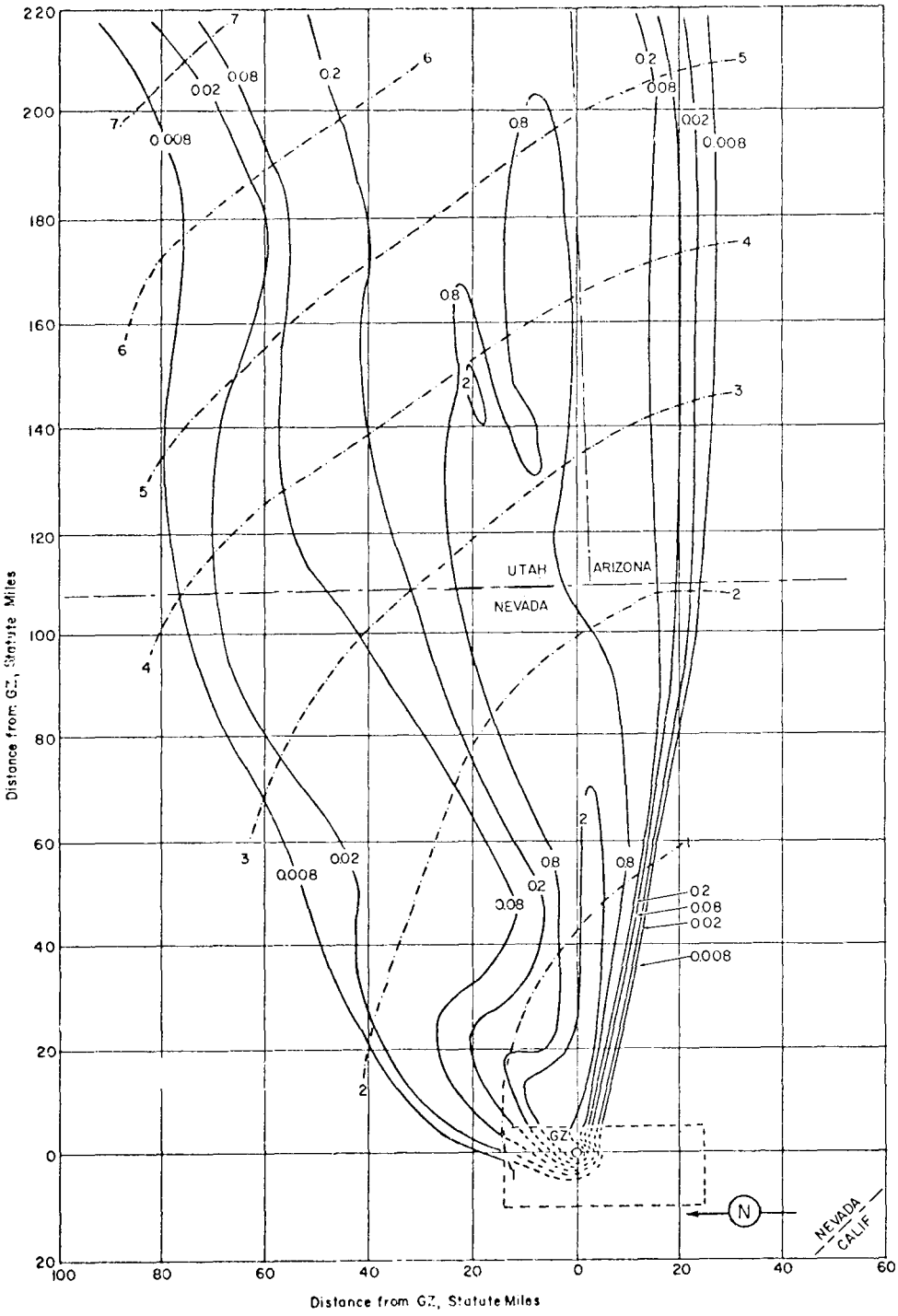

Figure 100. Operation UPSHOT-KNOTHOLE - Harry.
Off-site dose rate contours in r/hr at H+1 hour.

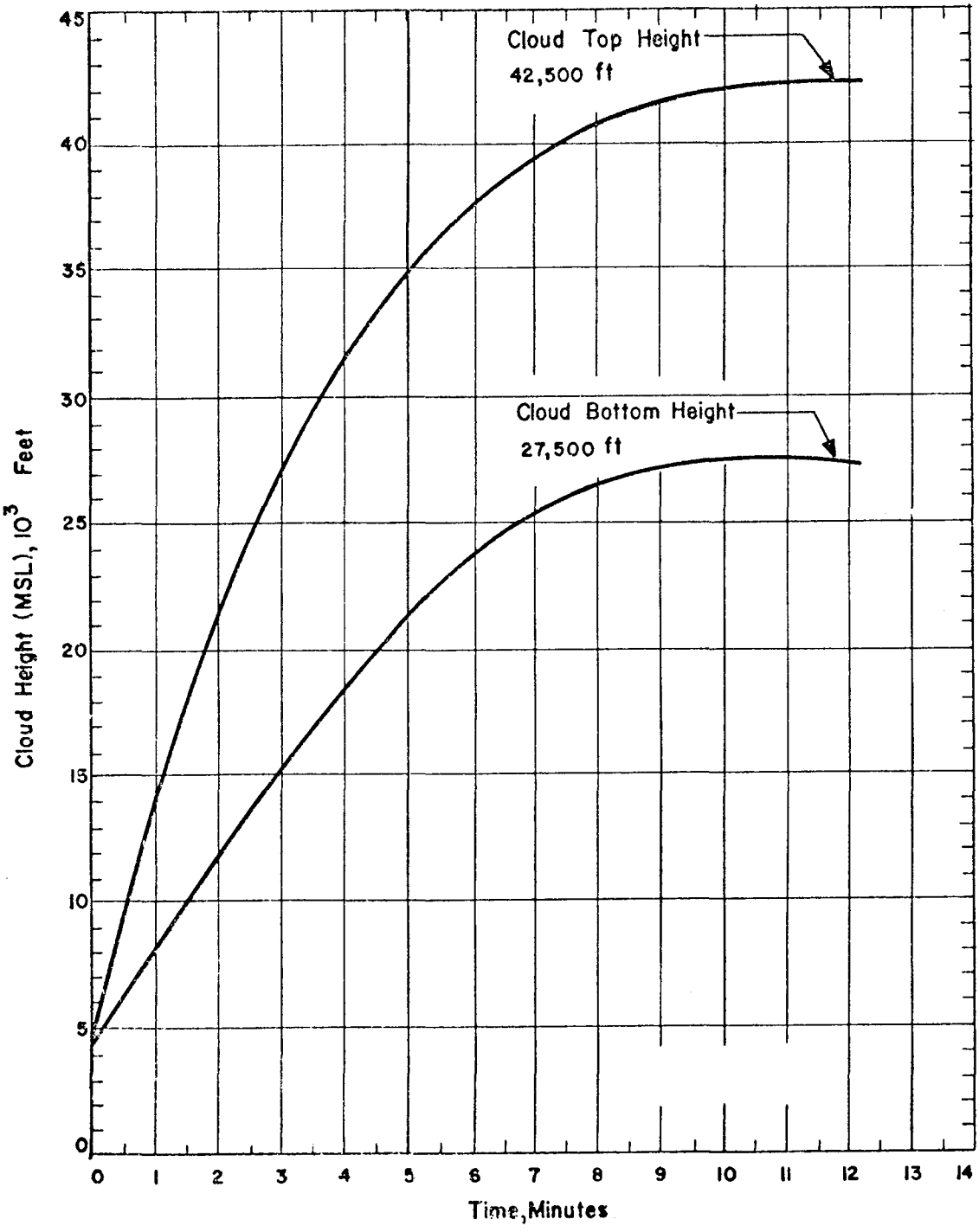

Figure 101. Cloud Dimensions: Operation UPSHOT-KNOTHOLE - Harry.

TABLE 30 WIND DATA FOR OPERATION UPSHOT-KNOTHOLE - HARRY

Altitude (MSL)	H-hour	
	Dir	Speed
feet	degrees	mph
Surface	020	06
Burst Height	200	06
5,000	200	12
6,000	200	24
7,000	200	29
8,000	200	30
9,000	210	26
10,000	210	21
11,000	210	17
12,000	200	17
13,000	210	17
14,000	220	20
15,000	230	24
16,000	260	35
17,000	270	40
18,000	270	43
19,000	270	43
20,000	280	44
21,000	280	48
22,000	280	55
23,000	280	57
24,000	280	63
25,000	280	62
26,000	290	57
27,000	290	53
28,000	280	51
29,000	280	57
30,000	290	69
31,000	290	81
32,000	290	77
33,000	290	74
34,000	290	74
35,000	290	72
36,000	290	74
37,000	290	77
38,000	290	74
39,000	300	69
40,000	300	77
41,000	300	85
42,000	300	91
43,000	280	90
44,000	280	87
45,000	280	89
46,000	280	86
47,000	280	87
48,000	280	92
49,000	280	84
50,000	280	72

NOTES:

1. Tropopause height was 40,500 ft MSL at H-hour.
2. H-hour surface wind data was obtained at the Control Point. H-hour upper air data was obtained from the rawinsonde section located on Yucca Lake. H+3 hour wind data was obtained from pibal observation at St. George.
3. At H-hour the pressure at ground zero was 874 mb, the temperature 14.3°C, the dew point -0.6°C, and the relative humidity 35%.

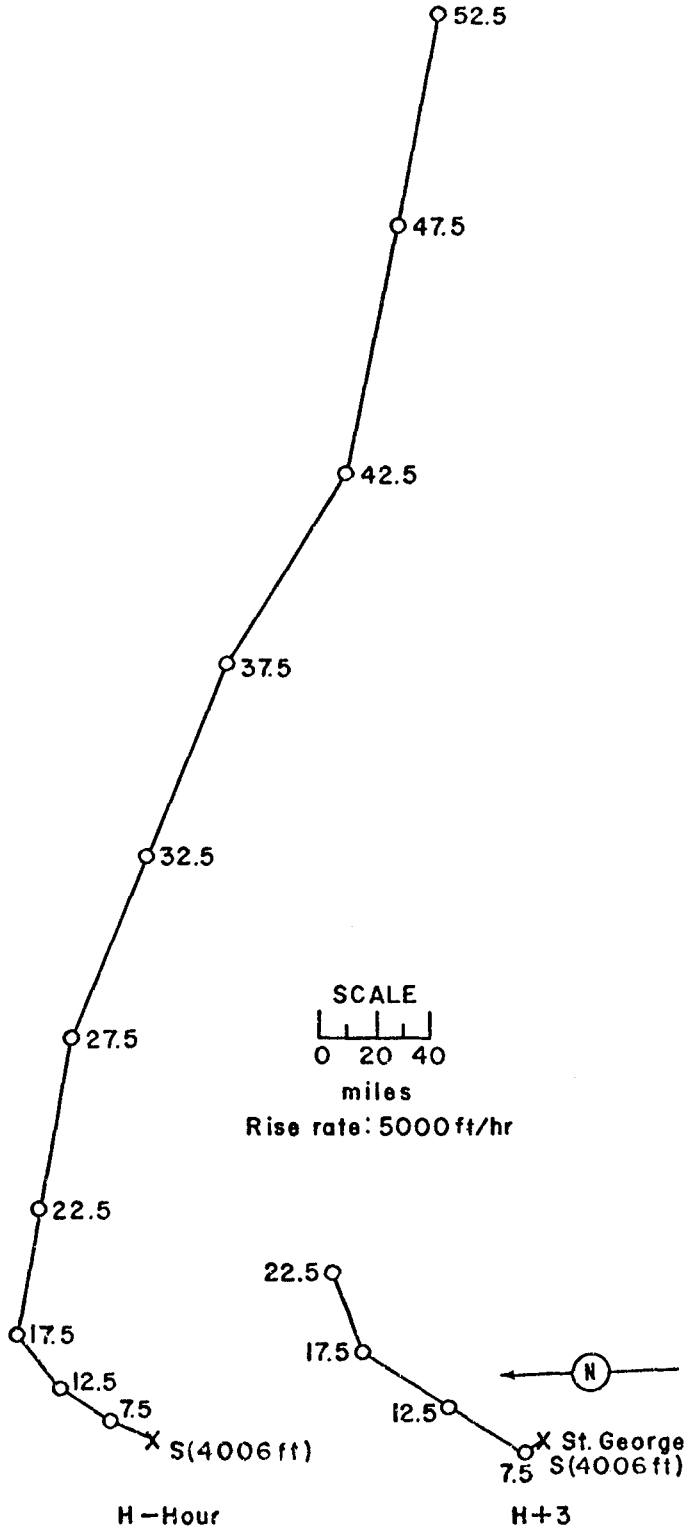

Figure 102. Hodographs for Operation UPSHOT-KNOTHOLE - Harry.

OPERATION UPSHOT-KNOTHOLE - Grable

	PST	GMT
DATE:	25 May 1953	25 May 1953
TIME:	0730	1530

Sponsor: LASL

SITE: NTS - Frenchman Flat
36° 47' 35" N
115° 54' 53" W
Site elevation: 3,077 ft

TOTAL YIELD: 15 kt

HEIGHT OF BURST: 524 ft

TYPE OF BURST AND PLACEMENT:
Airburst of guntype weapon over Nevada soil

FIREBALL DATA:
Time to 1st minimum: 13.3 to 14.9 msec
Time to 2nd maximum: 122 to 138 msec
Radius at 2nd maximum: 557.6

CLOUD TOP HEIGHT: 35,000 ft MSL
CLOUD BOTTOM HEIGHT: 23,000 ft MSL

CRATER DATA: No crater

REMARKS:

The on-site fallout pattern is due primarily to neutron induced activity and was obtained by the Radiological Safety organization from ground-survey measurements between H+$\frac{1}{4}$ hour and H+1$\frac{1}{4}$ hours. No decay corrections were necessary. The off-site fallout pattern was drawn from D-day readings of mobile ground-survey teams of the Radiological Safety organization.

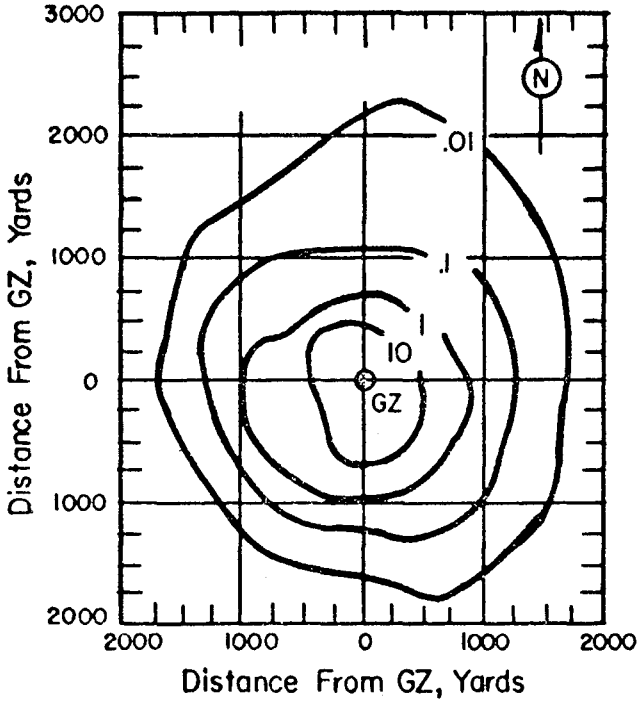

Figure 103. Operation UPSHOT-KNOTHOLE - Grable.
On-site dose rate contours in r/hr at H+1 hour.

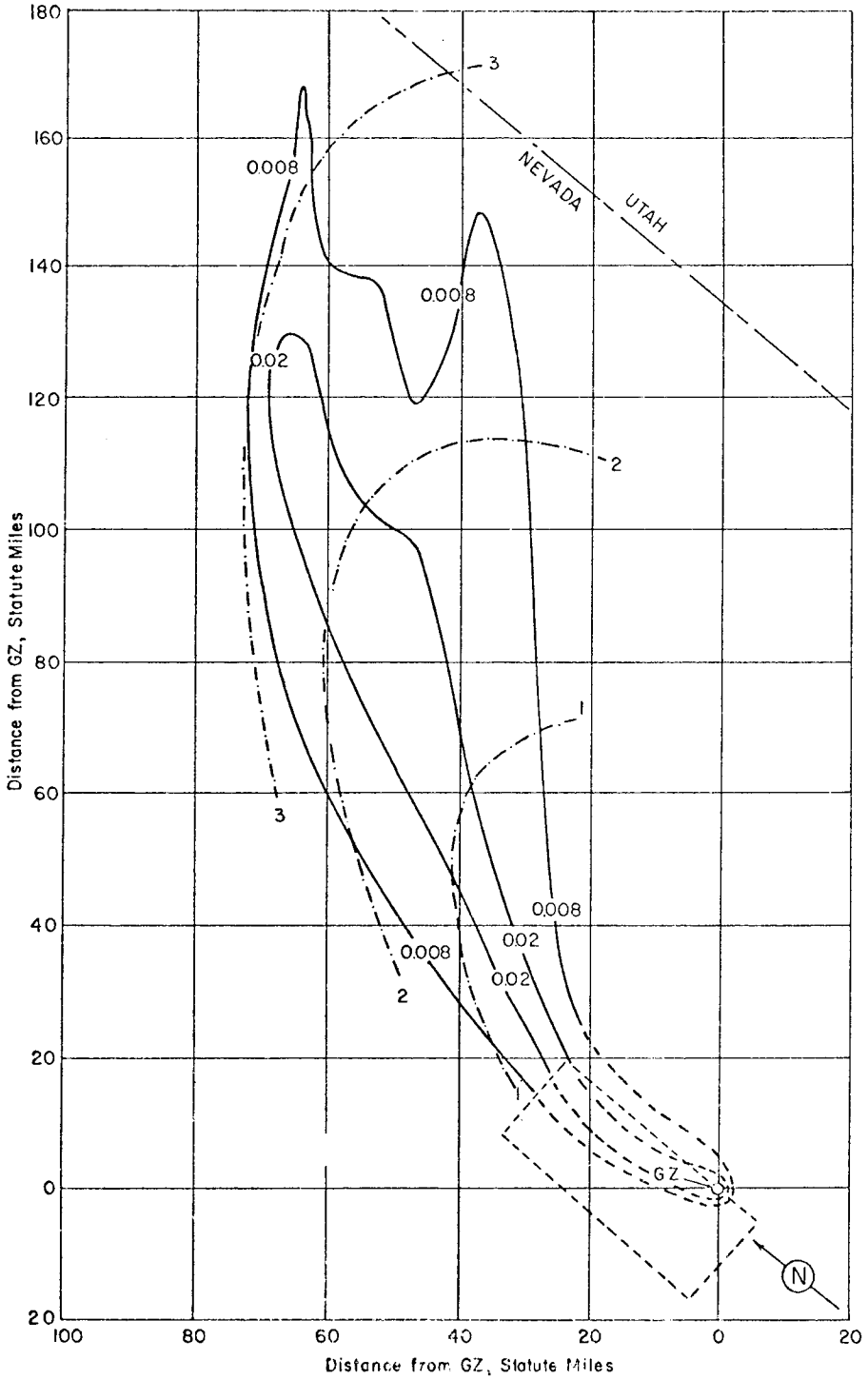

Figure 104. Operation UPSHOT-KNOTHOLE - Grable.
Off-site dose rate contours in r/hr at H+1 hour.

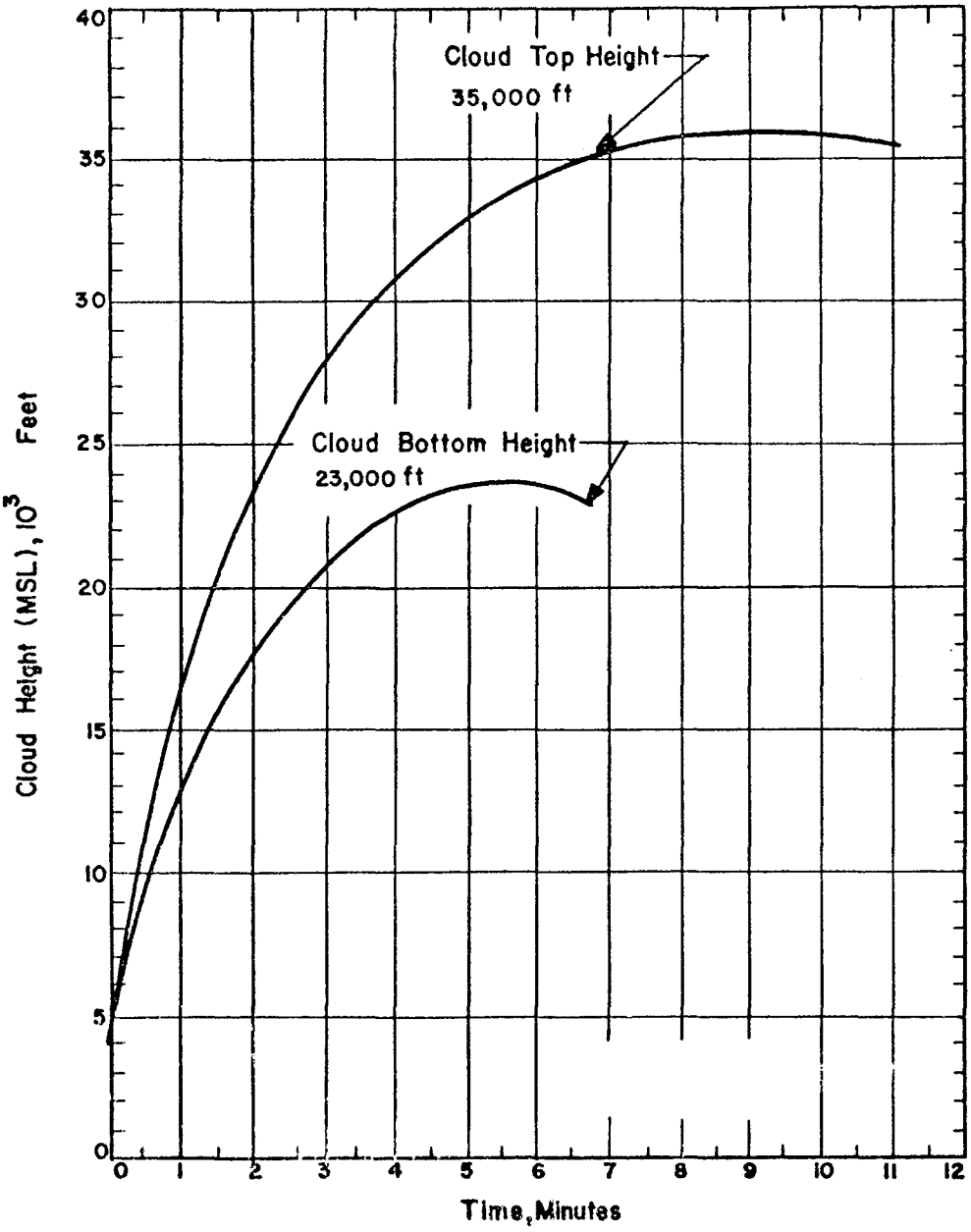

Figure 105. Cloud Dimensions: Operation UPSHOT-KNOTHOLE - Grable.

TABLE 31 NEVADA WIND DATA FOR OPERATION UPSHOT-KNOTHOLE - GRABLE

Altitude (MSL)	H-hour	
	Dir	Speed
feet	degrees	mph
Surface	360	05
Burst Height	220	08
4,000	220	12
5,000	220	16
6,000	190	24
7,000	180	35
8,000	190	24
9,000	190	24
10,000	200	35
11,000	200	35
12,000	200	36
13,000	200	37
14,000	200	38
15,000	200	40
16,000	200	55
17,000	210	63
18,000	210	85
19,000	210	85
20,000	220	85
21,000	220	86
22,000	220	87
23,000	220	94
24,000	220	101
25,000	220	75
26,000	220	63
27,000	220	102
28,000	220	102
29,000	220	92
30,000	220	98
31,000	220	124
32,000	220	126
33,000	220	125
34,000	220	120
35,000	220	138
36,000	220	140
37,000	220	100
38,000	220	103
39,000	220	95
40,000	220	75
41,000	220	85
42,000	220	91
43,000	220	72
44,000	220	61
45,000	220	65
46,000	220	64
47,000	220	63
48,000	220	77
49,000	220	60
50,000	220	38

NOTES:

1. Tropopause height was 35,400 ft MSL at H-hour.
2. Surface and lower level wind data was obtained at the Control Point. Upper air data was obtained from the rawinsonde section located on Yucca Lake.
3. At H-hour the pressure at ground zero was 901 mb, the temperature 14.8°C, the dew point -3.8°C and the relative humidity 32%.

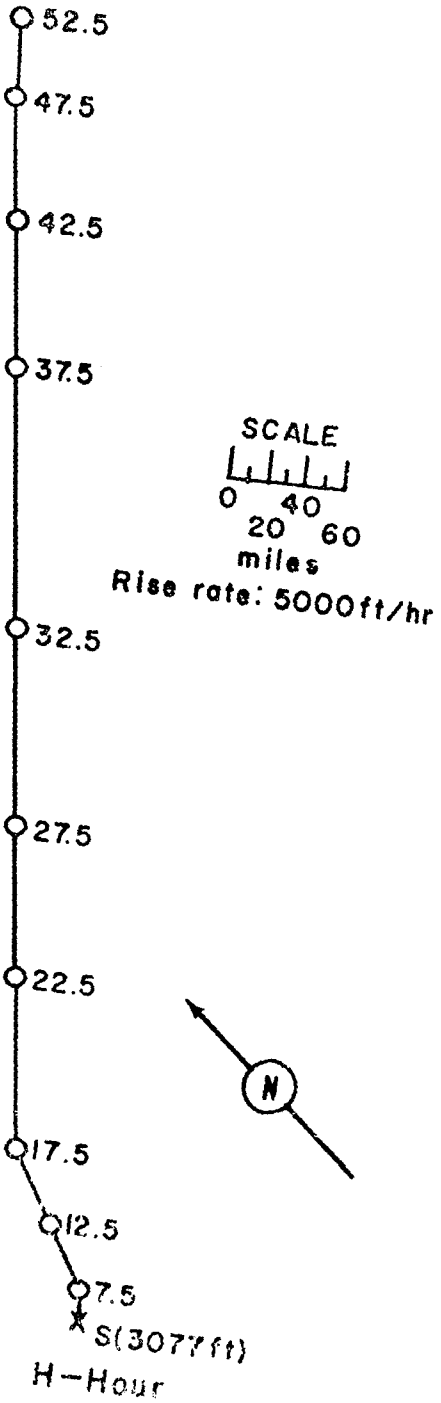

Figure 106. Hodograph for Operation UPSHOT-KNOTHOLE - Grable

OPERATION UPSHOT-KNOTHOLE - Climax

	PST	GMT
DATE:	4 Jun 1953	4 Jun 1953
TIME:	0315	1115

Sponsor: LASL

SITE: NTS - Area 7 - 3
37° 05' 15" N
116° 01' 06" W
Site elevation: 4,025 ft

TOTAL YIELD: 61 kt

HEIGHT OF BURST: 1,334 ft

FIREBALL DATA:
Time to 1st minimum: 27.0 to 27.2 msec
Time to 2nd maximum: 250 to 257 msec
Radius at 2nd maximum: 918.4 ft

TYPE OF BURST AND PLACEMENT:
Air burst over Nevada soil

CLOUD TOP HEIGHT: 42,700 ft MSL
CLOUD BOTTOM HEIGHT: 35,000 ft MSL

CRATER DATA: No crater

REMARKS:

The contamination was due primarily to neutron-induced activity. The on-site pattern was drawn from H+1-hour readings. No decay corrections were necessary. Little fallout was detected within the 200-mile zone. All downwind readings were only slightly above normal background.

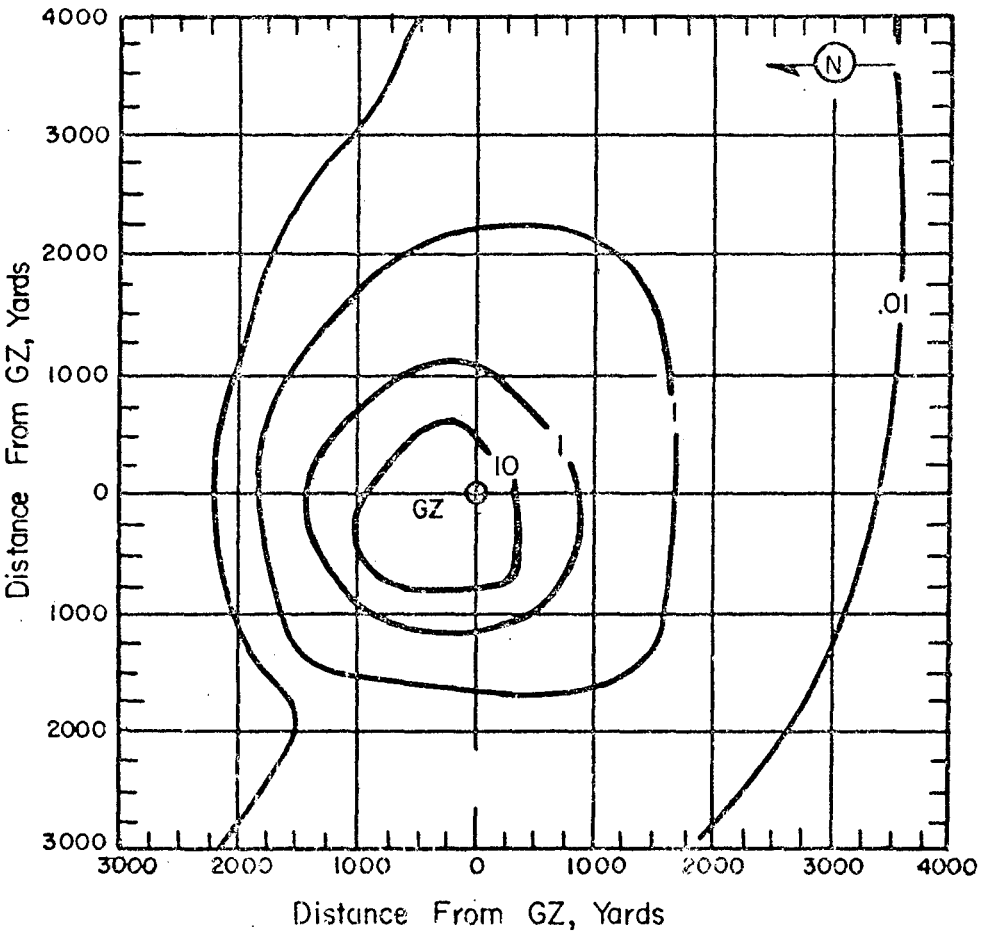

Figure 107. Operation UPSHOT-KNOTHOLE - Climax.
On-site dose rate contours in r/hr at H+1 hour.

OPERATION TEAPOT - Ess

	PST	GMT
DATE:	23 Mar 1955	23 Mar 1955
TIME:	1230	2030

TOTAL YIELD: 1 kt

FIREBALL DATA:
Time to 1st minimum: NM
Time to 2nd maximum: NM
Radius at 2nd maximum: NM

CRATER DATA: Diameter: 292 ft
Depth: 96 ft
Maximum Dose Rate: 6000 r/hr at H+1 hour at crater lip (extrapolated from readings taken at H+2 hours)

Sponsor: DOD-LASL

SITE: NTS - Area T-10a
37° 10' 06" N
116° 02' 38" W
Site elevation: 4,288 ft

TYPE OF BURST AND PLACEMENT:
Subsurface burst in filled shaft

HEIGHT OF BURST: -67 ft

CLOUD TOP HEIGHT: 12,000 ft MSL
CLOUD BOTTOM HEIGHT: NM

REMARKS:

The close-in and on-site fallout patterns were constructed from extensive and detailed ground and aerial survey readings of scientific projects and are considered to be accurate.

The off-site fallout pattern was drawn from ground-survey readings taken by the off-site Radiological Safety organization. The $t^{-1.2}$ decay approximation was used to extrapolate the dose-rate readings to H+1 hour for both on-site and off-site patterns. Some residual contamination from Shot 6 - Bee is included in the readings.

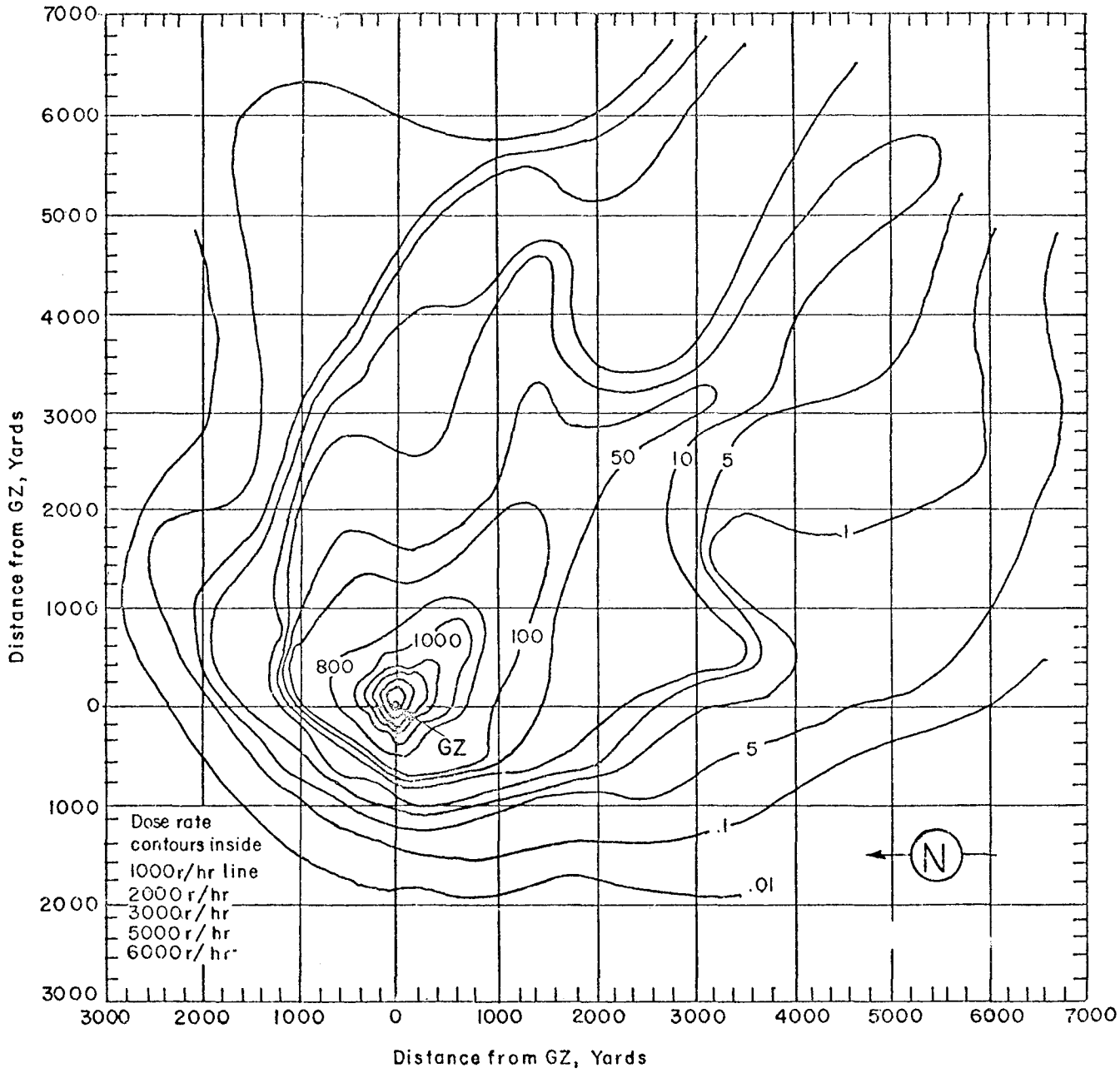

Figure 133. Operation TEAPOT - Ess.
Close-in dose rate contours in r/hr at H+1 hour.

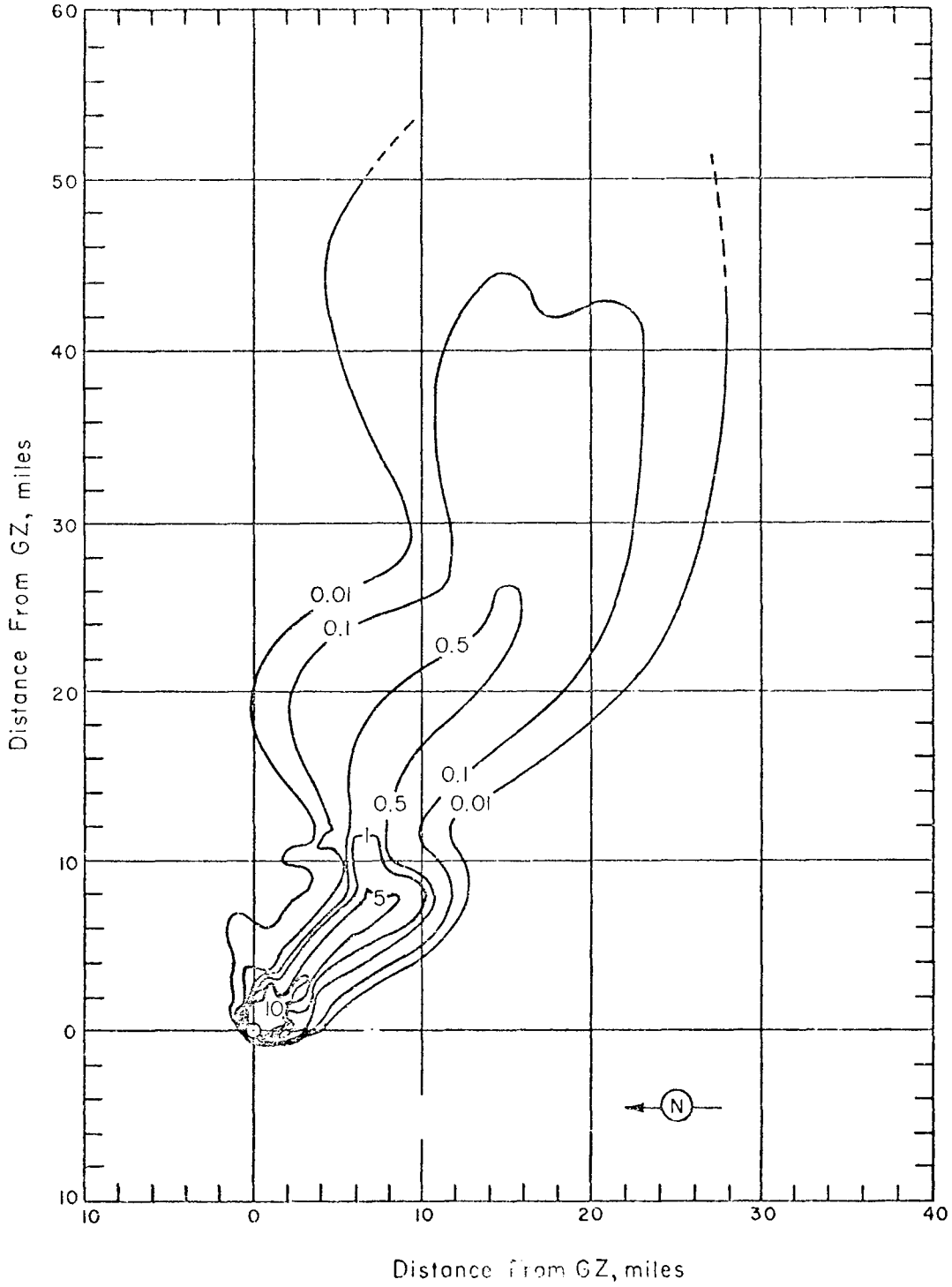

Figure 134. Operation TEAPOT - Ess.
On-site dose rate contours in r/hr at H+1 hour.

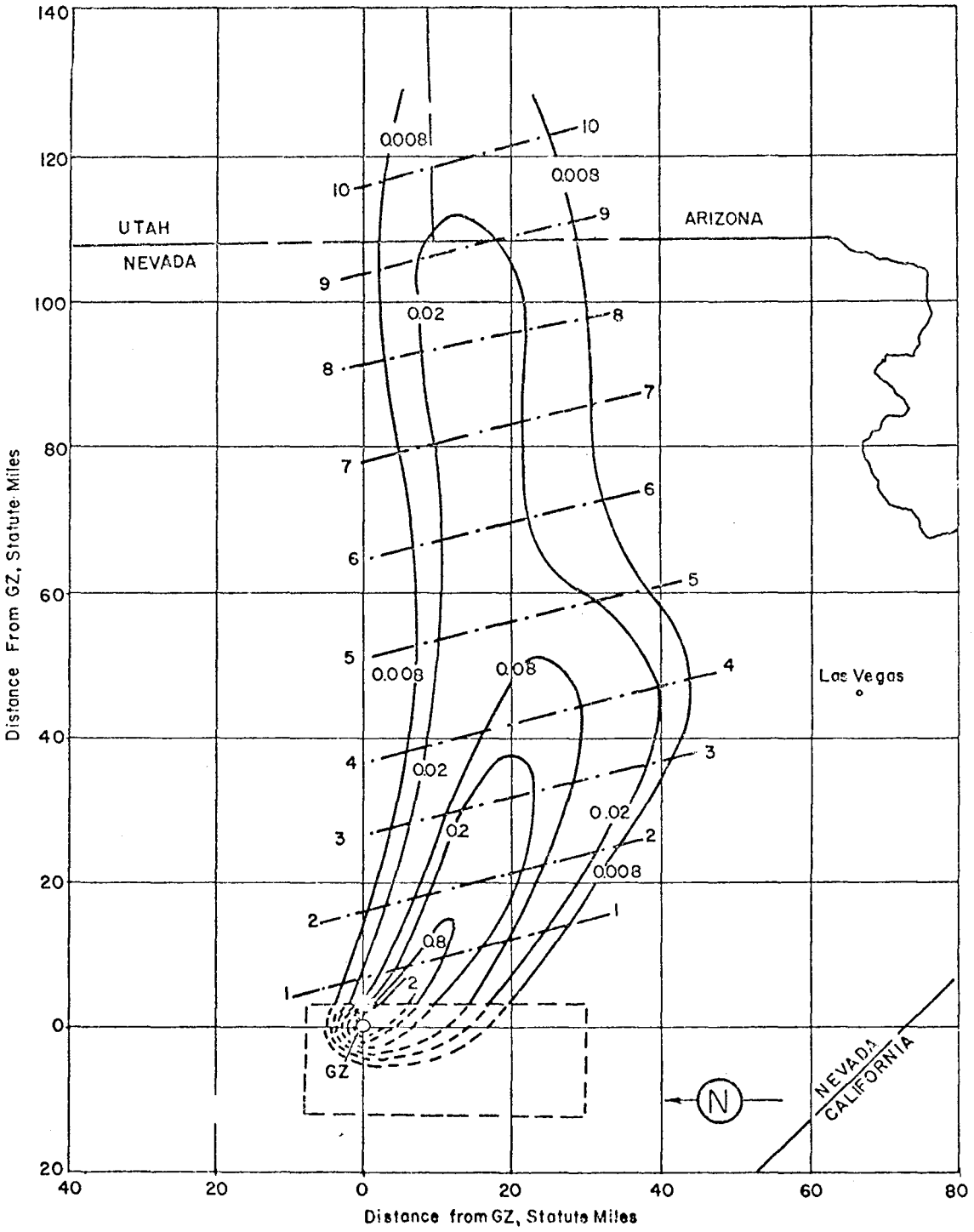

Figure 135. Operation TEAPOT - Ess.
Off-site dose rate contours in r/hr at H+1 hour.

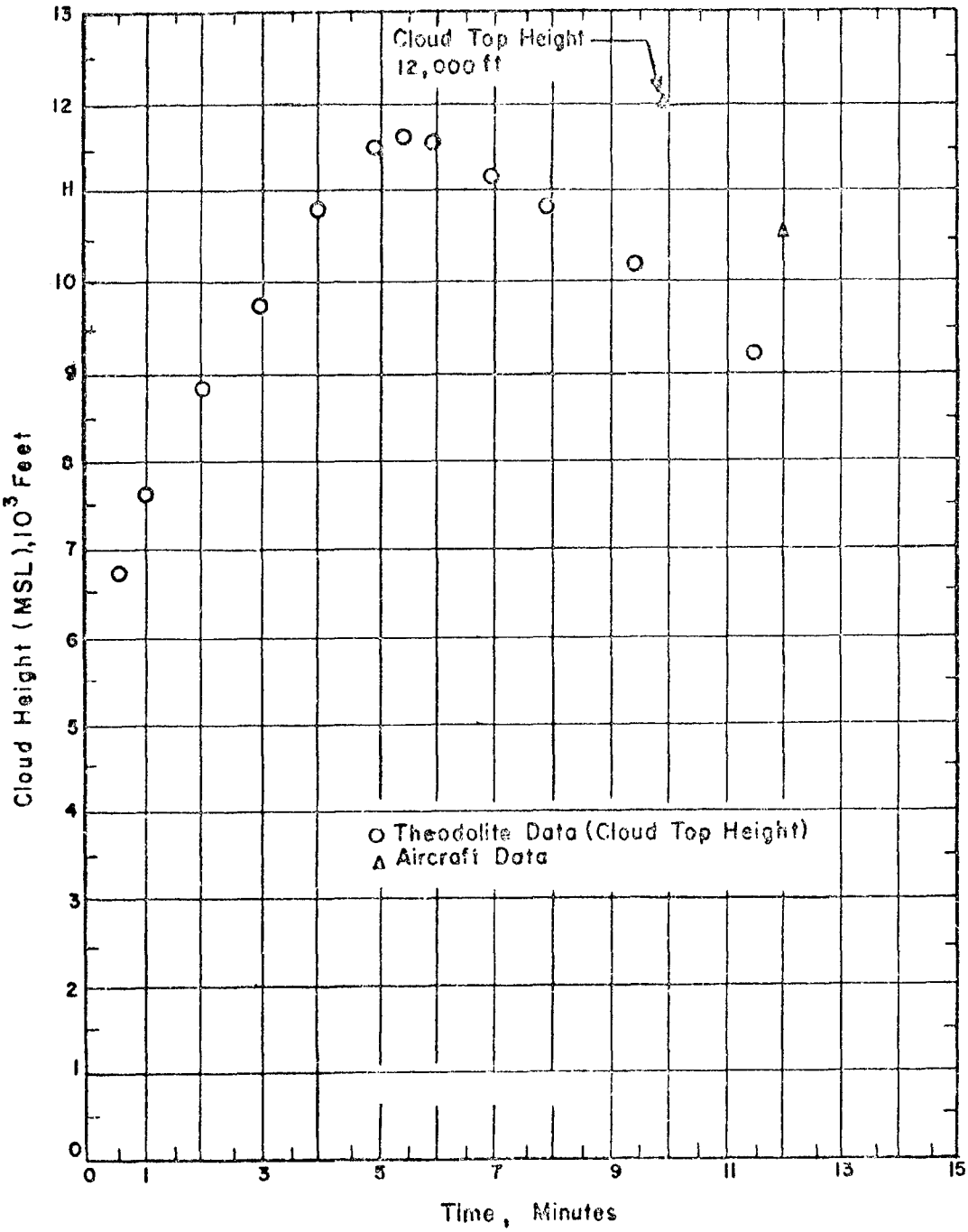

Figure 136. Cloud Dimensions: Operation TEAPOT - Ess.

TABLE 39 NEVADA WIND DATA FOR OPERATION TEAPOT- ESS

Altitude (MSL)	H-hour	
	Dir	Speed
feet	degrees	mph
Surface	310	12
5,000	310	14
6,000	310	17
7,000	320	17
8,000	320	18
9,000	330	23
10,000	340	29
11,000	350	26
12,000	360	29
13,000	340	26
14,000	330	29
15,000	330	36
16,000	310	39
17,000	300	40
18,000	290	41
19,000	290	40
20,000	290	43
21,000	290	43
22,000	290	46
23,000	290	50
24,000	290	55
25,000	290	54
30,000	290	66
35,000	300	59

NOTES:

1. Tropopause height was 39,000 ft MSL.
2. At the surface the temperature was 18.0°C and the pressure 883 mb.

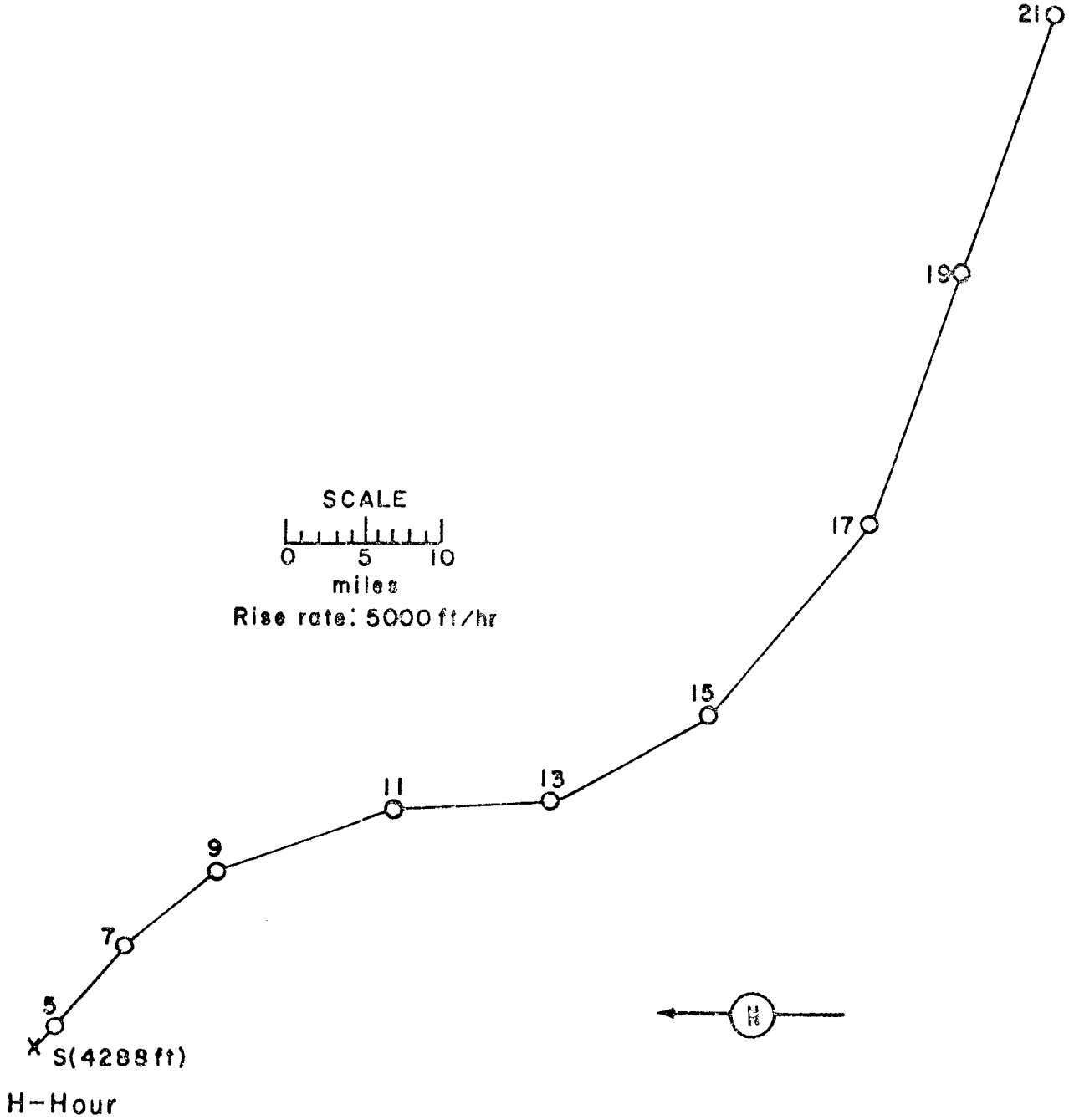

Figure 137. Hodograph for Operation TEAPOT - Ess.

OPERATION PLUMBBOB - Safety Experiment No. 5 - 57 Test Group

	PST	GMT
DATE:	24 Apr 1957	24 Apr 1957
TIME:	0627	1427

Sponsor: LASL - DOD

SITE: NTS - Area 13
Site elevation: 4,585 ft

HEIGHT OF BURST: Surface

TYPE OF BURST AND PLACEMENT:
Surface burst on Nevada soil

CLOUD TOP HEIGHT: 750 ft
CLOUD BOTTOM HEIGHT: 400 ft

REMARKS:

Only alpha contamination was observed. The survey was made with gas proportional alpha counters (Model PAC-1G) over concrete pads. The concrete pads were placed next to fallout collectors. The alpha-survey contours were adjusted by using results of radiochemical analyses of the fallout collector contents.

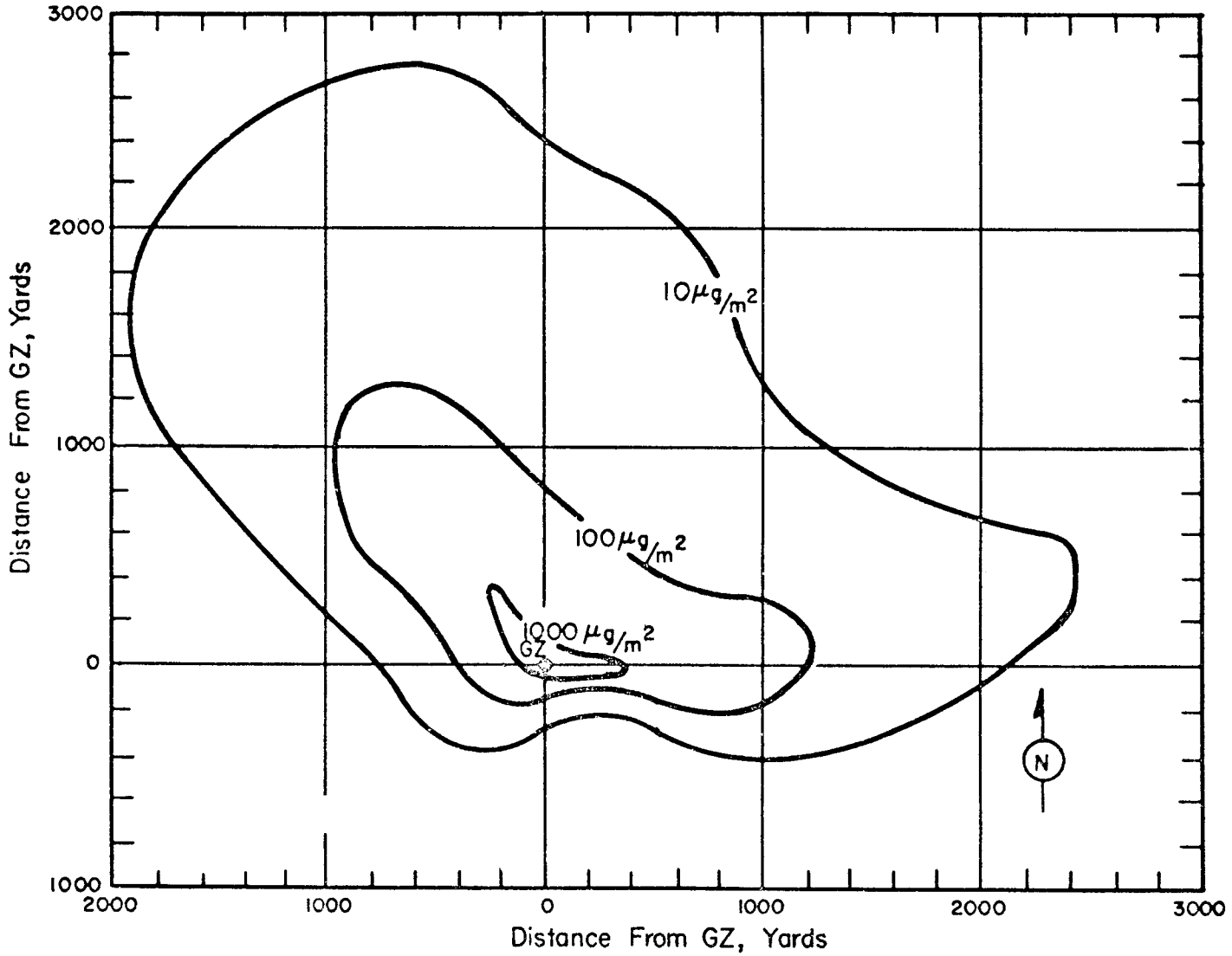

Figure 165. Operation PLUMBBOB - Safety Experiment No. 5 - 57 Test Group. On-site alpha contamination in micrograms per square meter.

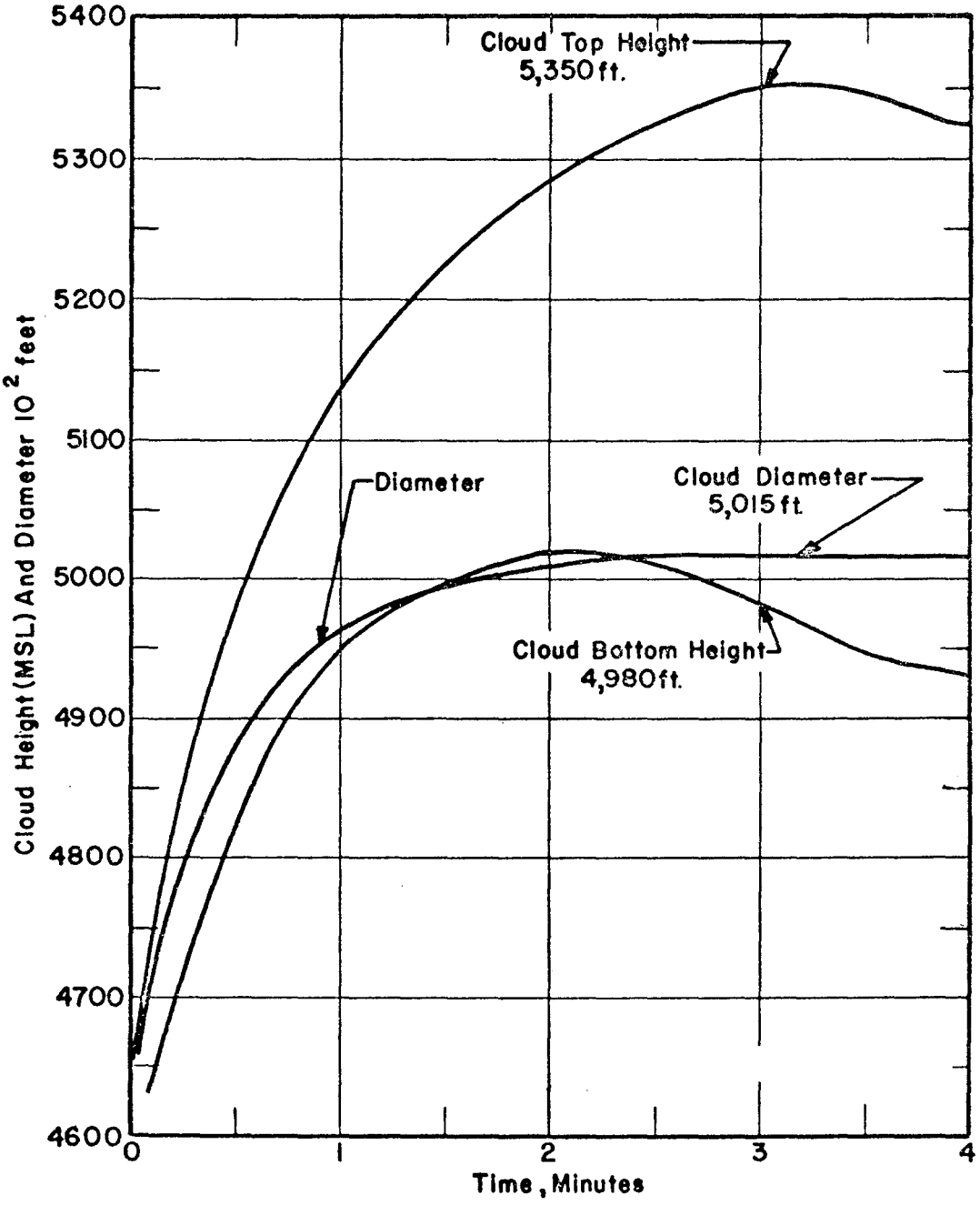

Figure 166. Cloud Dimensions: Operation PLUMBBOB
Safety Experiment No. 5 - 57 Test Group

NEVADA WIND DATA FOR OPERATION PLUMBBOB SAFETY EXPERIMENT NO. 5 - 57 TEST GROUP

Wind velocities were measured using theodolites at two stations during the period H-2 hours to H+1½ hours. Light winds (2 to 6 miles per hour) and high shear existed during the period of observation for the height range, surface to 1000 feet. The resulting hodographs from the two stations differ markedly from each other and are not consistent with the observed alpha contamination pattern. Probably the best description of the mean wind structure is provided by a reconstruction based upon ground and aerial photography of the cloud. The hodograph shown in figure 279 is based upon such photographic observations

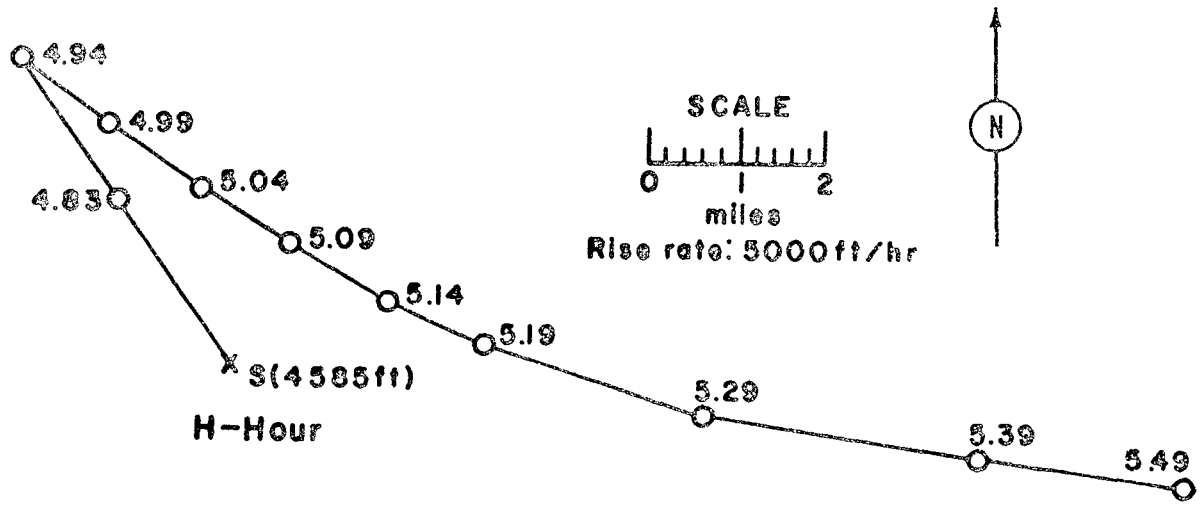

Figure 167. Hodograph for Operation PLUMBBOB Safety Experiment No. 5 - 57 Test Group.

OPERATION PLUMBBOB - Wilson

	PDT	GMT
DATE:	18 Jun 1957	18 Jun 1957
TIME:	0445	1145

TOTAL YIELD: 10 kt

FIREBALL DATA:
Time to 1st min.: NM
Time to 2nd max.: 133 msec
Radius at 2nd max: NM

CRATER DATA: No crater

Sponsor: UCRL

SITE: NTS - Area 9a
37° 08' 05" N
116° 02' 27" W
Site elevation: 4,230 ft

HEIGHT OF BURST: 500 ft

TYPE OF BURST AND PLACEMENT:
Air burst from balloon over Nevada soil

CLOUD TOP HEIGHT: 35,000 ft MSL
CLOUD BOTTOM HEIGHT: 25,000 ft MSL

REMARKS:

On-site contamination was primarily due to induced activity. The on-site pattern was obtained from ground survey readings of the Radiological Safety Division of Reynolds Electrical and Engineering Co., Inc., using AN/PDR 43 and AN/PDR 39 survey instruments. The readings were taken at H+2 hours, D+1 day, D+2 days and D+3 days along eight radial roads to determine radiation exclusion areas. The dose-rate readings are not reliable because the induced-activity-decay curve is not strictly applicable to a mixture of fission products and induced activities. Decay measurements indicated a decay rate similar to Na^{24} for distances out to 1,200 yards from GZ. The off-site fallout was analyzed by Program 37 of UCLA and the USWB Special Projects Section. They used actual decay data to plot the H+12 hour dose-rate contours. The $t^{-1.2}$ decay approximation was used by NDL to extrapolate the H+12 hour dose-rate contours to H+1 hour. The times of arrival were estimated from the wind data.

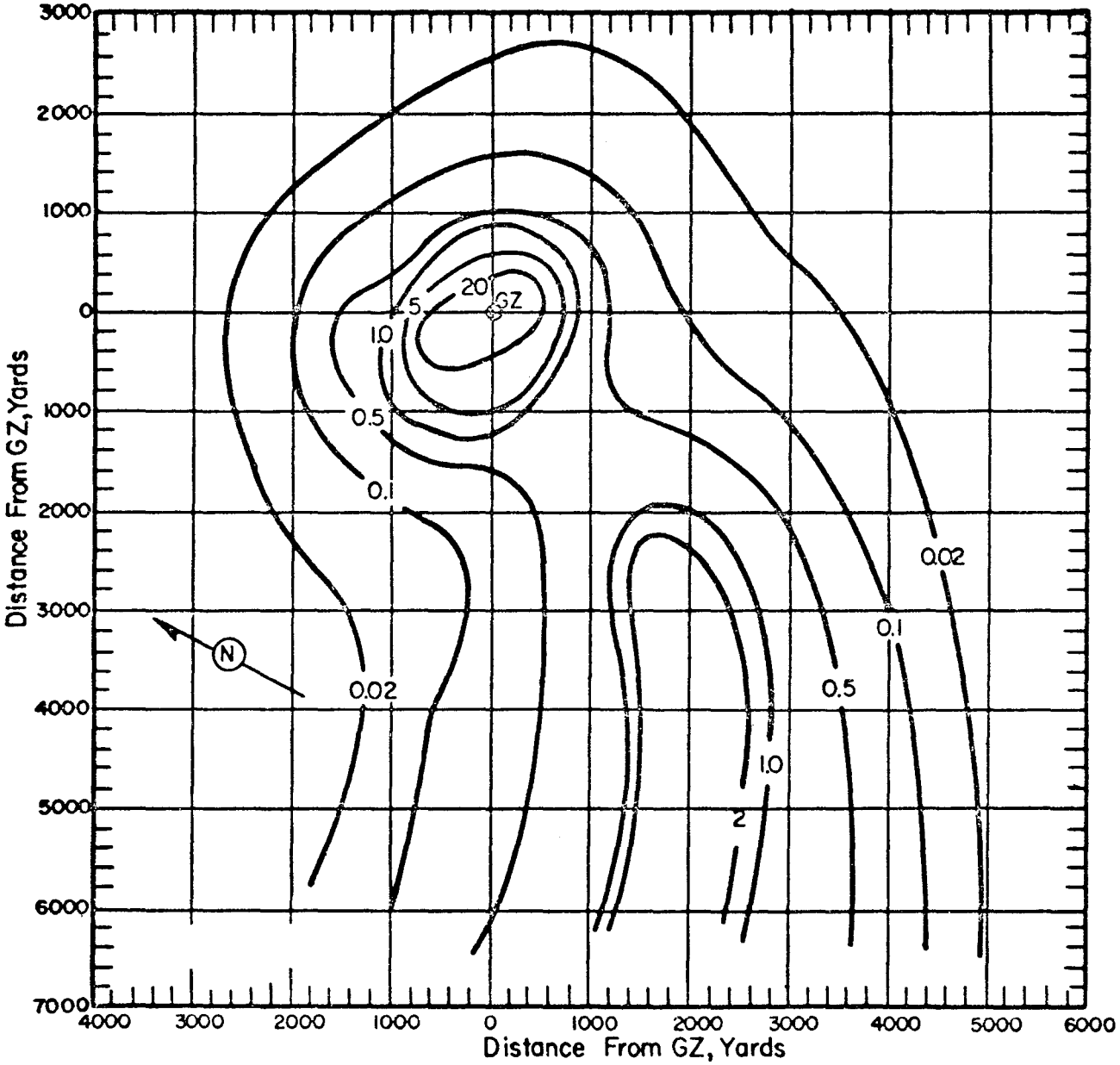

Figure 175. Operation PLUMBBOB - Wilson. On-site dose rate contours in r/hr at H+1 hour.

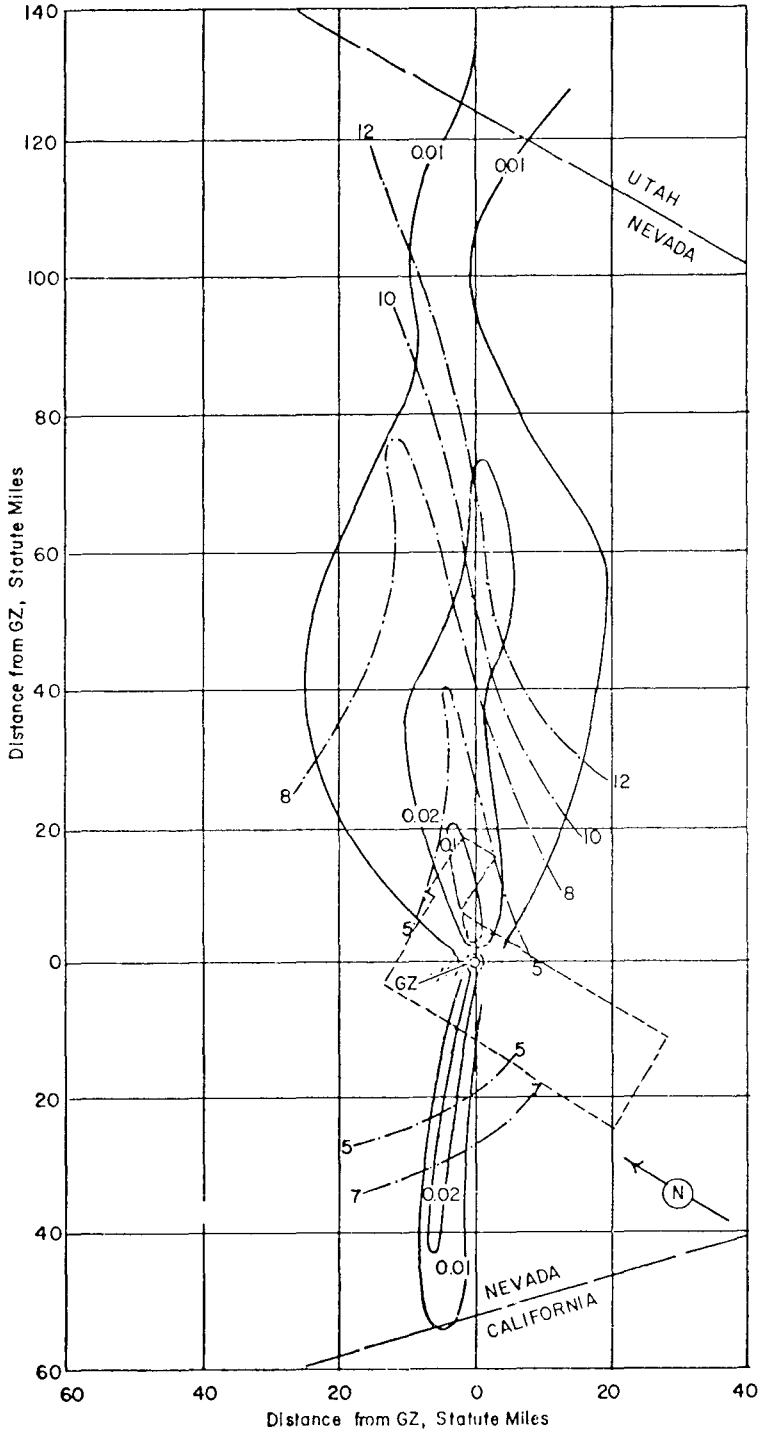

Figure 176. Operation PLUMBBOB - Wilson. Off-site dose rate contours in r/hr at H+1 hour.

TABLE 50 NEVADA WIND DATA FOR OPERATION PLUMBBOB- WILSON

Altitude (MSL)	H-hour		H+3 hours		Altitude (MSL)	H-hour		H+3 hours	
	Dir	Speed	Dir	Speed		Dir	Speed	Dir	Speed
feet	degrees	mph	degrees	mph	feet	degrees	mph	degrees	mph
Surface	340	05	340	02	28,000	220	15	---	--
5,000	030	10	010	06	29,000	230	20	---	--
6,000	060	12	040	09	30,000	240	18	220	20
7,000	080	12	060	12	31,000	240	17	---	--
8,000	070	12	070	12	32,000	230	23	---	--
9,000	060	12	060	12	33,000	230	26	---	--
10,000	060	09	060	12	34,000	240	24	---	--
11,000	050	12	---	--	35,000	240	22	230	21
12,000	080	09	080	06	36,000	240	22	---	--
13,000	150	05	---	--	37,000	240	22	---	--
14,000	310	02	340	08	38,000	240	22	---	--
15,000	300	05	(340)	(08)	39,000	240	22	---	--
16,000	290	02	330	07	40,000	240	24	230	25
17,000	310	09	---	--	41,000	230	26	---	--
18,000	290	09	320	10	42,000	240	24	---	--
19,000	260	09	---	--	43,000	250	20	---	--
20,000	250	09	280	14	44,000	260	17	---	--
21,000	230	09	---	--	45,000	260	17	240	28
22,000	220	09	---	--	46,000	260	20	---	--
23,000	220	10	220	16	47,000	250	24	---	--
24,000	220	13	---	--	48,000	250	25	---	--
25,000	220	14	220	17	49,000	260	24	---	--
26,000	210	13	---	--	50,000	260	21	260	21
27,000	210	12	---	--	51,000	260	16	---	--
					52,000	260	13	---	--
					53,000	260	10	---	--
					54,000	260	10	---	--

NOTES:

1. Numbers in parentheses are estimated values.
2. Tropopause height was 40,000 ft MSL at H-hour.
3. Wind data was obtained from the Yucca weather station.
4. At H-hour the surface air pressure was 882 mb, the temperature 17.0°C, the dew point 2.8°C and the relative humidity 38%.

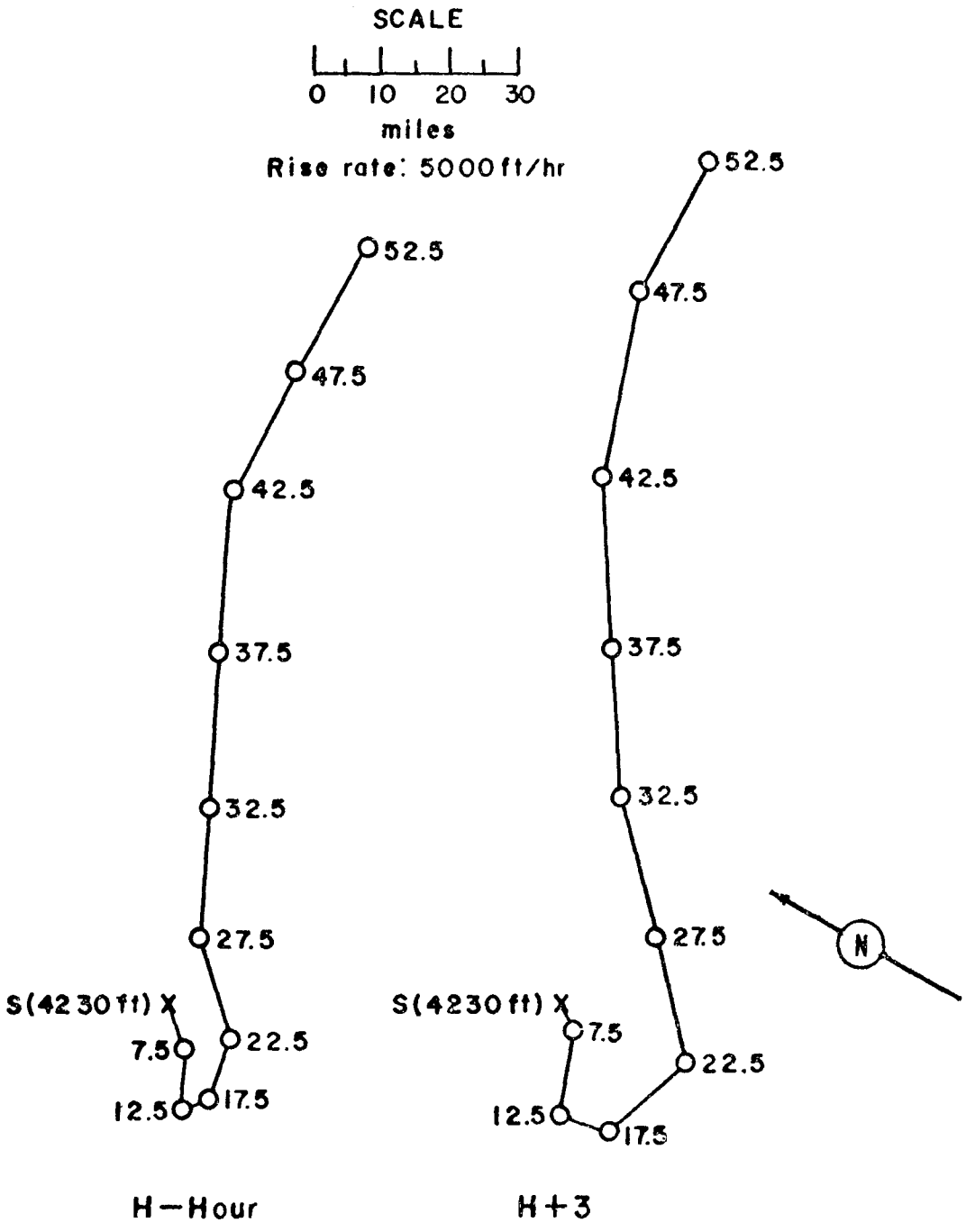

Figure 177. Hodographs for Operation PLUMBBOB - Wilson.

OPERATION PLUMBBOB - Hood

	PDT	GMT
DATE:	5 Jul 1957	5 Jul 1957
TIME:	0440	1140

TOTAL YIELD: 74 kt

FIREBALL DATA:
Time to 1st minimum: NM
Time to 2nd maximum: 276 to 280 msec
Radius at 2nd maximum: NM

CRATER DATA: No Crater

Sponsor: UCRL

SITE: NTS - Area 9a
37° 08' 05" N
116° 02' 27" W
Site elevation: 4,230 ft

HEIGHT OF BURST: 1,500 ft

TYPE OF BURST AND PLACEMENT:
Air burst from balloon over Nevada soil

CLOUD TOP HEIGHT: 48,000 ft MSL
CLOUD BOTTOM HEIGHT: 35,000 ft MSL

REMARKS:
On-site contamination was due primarily to induced activities. The on-site dose rate contours were obtained from ground survey readings of the Radiological Safety Division of Reynolds Electrical and Engineering Company, Inc., using AN/PDR 39 and AN/PDR 43 survey instruments. The readings were taken at H+1 hour, H+6 hours, D+1 day, D+2 days and D+3 days. The neutron induced-activity-decay curve for Nevada soil was used to extrapolate the dose-rate readings to H+1 hour. Few readings were taken to the north and east of ground zero because of rough terrain and numerous brush fires ignited by the detonation. The off-site fallout was analyzed by Program 37 of UCLA and the USWB Special Projects Section. They used actual decay data to plot the H+12 hour dose-rate contours. The $t^{-1.2}$ decay approximation was used by NDL to extrapolate the H+12 hour dose-rate contours to H+1 hour. The fallout pattern is based on ground and aerial survey data.

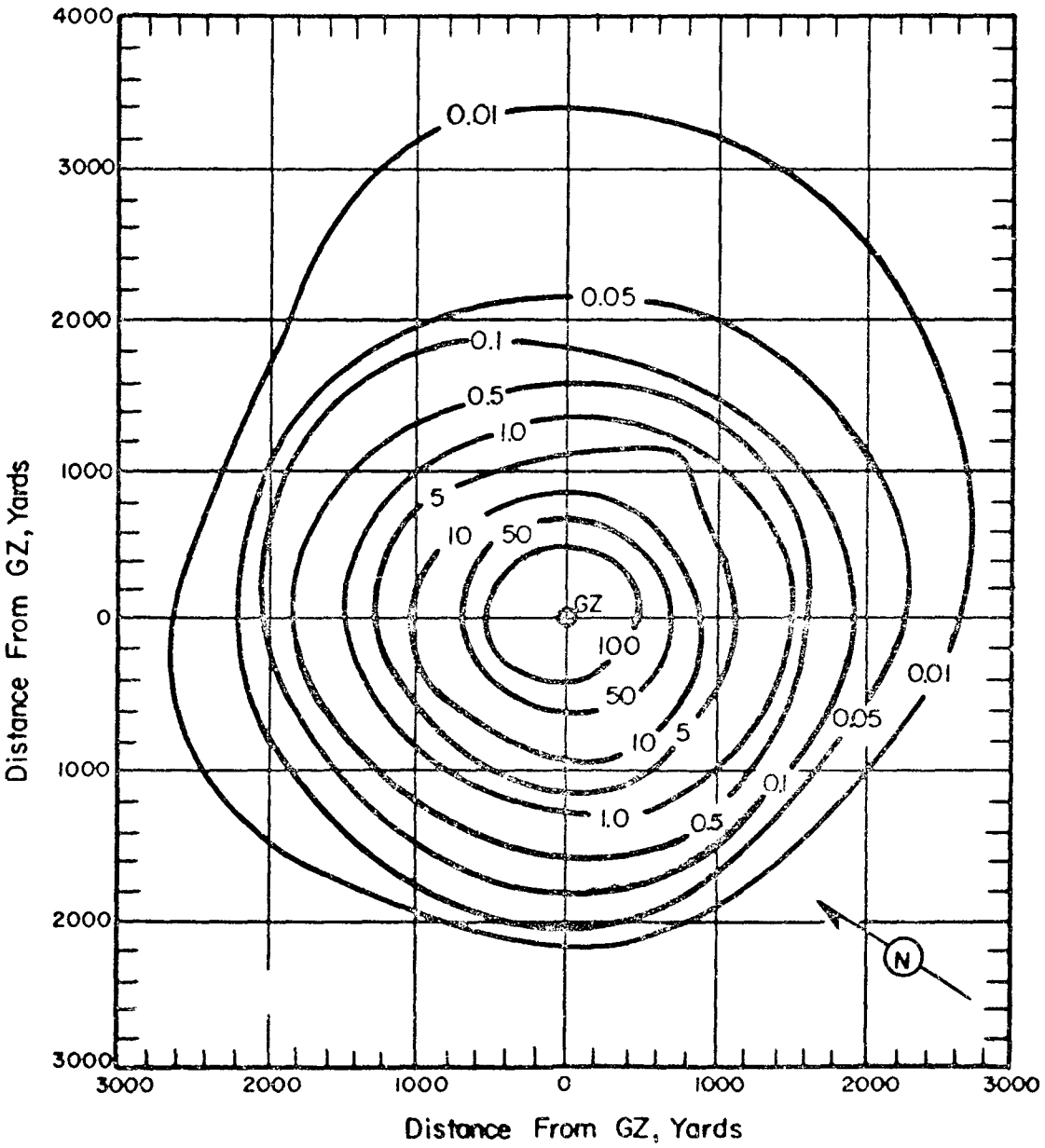

Figure 181. Operation PLUMBBOB - Hood. On-site dose rate contours in r/hr at H+1 hour.

OPERATION PLUMBBOB - Morgan

	PST	GMT
DATE:	7 Oct 1957	7 Oct 1957
TIME:	0500	1300

TOTAL YIELD: 8 kt

Sponsor: UCRL

SITE: NTS - Area 9a
37° 08' 05" N
116° 02' 27" W
Site elevation: 4,214 ft

HEIGHT OF BURST: 500 ft

FIREBALL DATA:
Time to 1st minimum: NM
Time to 2nd maximum: NM
Radius at 2nd maximum: NM

CRATER DATA: No crater

TYPE OF BURST AND PLACEMENT:
Air burst from balloon over Nevada soil

CLOUD TOP HEIGHT: 40,000 ft MSL
CLOUD BOTTOM HEIGHT: 26,000 ft MSL

REMARKS:

The contamination was due primarily to induced activity. The on-site pattern was obtained from ground survey readings of the Radiological Safety Division of Reynolds Electrical and Engineering Company, Inc., using AN/PDR 39 and AN/PDR 43 survey meters. The readings were taken at H+$\frac{3}{4}$ hour, H+6 hours, D+1 day, D+2 days and D+3 days along eight radial roads to determine radiation exclusion areas. The dose-rate readings were extrapolated to H+1 hour by the general induced-activity-decay curve for Nevada soil

The off-site fallout was analyzed by the USWB Special Projects Section. The $t^{-1.2}$ decay approximation was used to extrapolate the dose-rate readings to H+1 hour. "The Morgan debris apparently fell over or near residual debris from Smoky, but the uncertainties in the decay law and in the effects of weathering make it impossible to determine the Morgan pattern with any certainty"

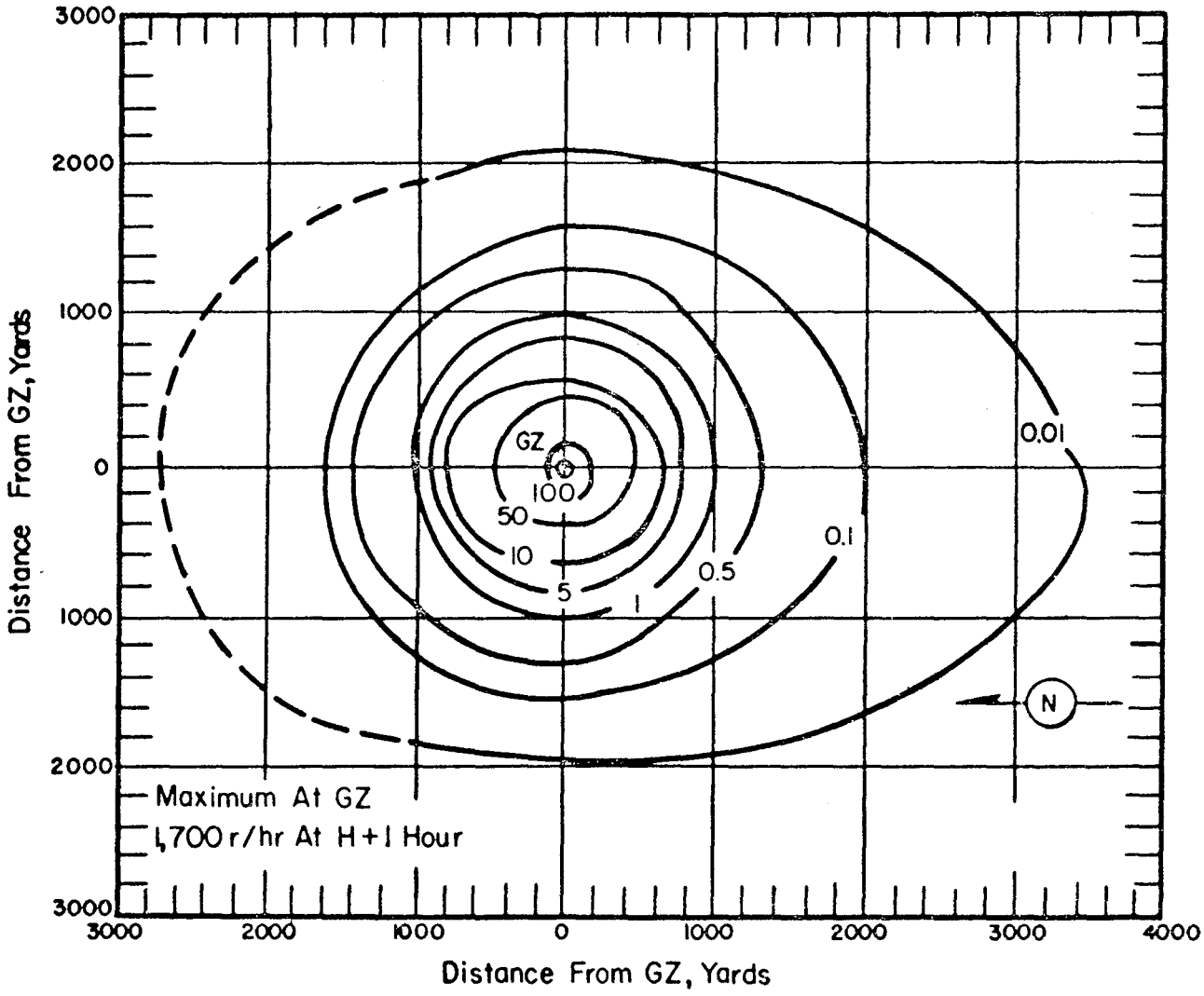

Figure 230 . Operation PLUMBBOB - Morgan.
On-site dose rate contours in r/hr at H+1 hour.

58 PROJECT - Coulomb C Safety Experiment

	PST	GMT
DATE:	9 Dec 1957	9 Dec 1957
TIME:	1200	2000

TOTAL YIELD: 0.5 kt

FIREBALL DATA:
Time to 1st minimum: NM
Time to 2nd maximum: NM
Radius at 2nd maximum: NM

CLOUD TOP HEIGHT: 13,000 ft MSL
CLOUD BOTTOM HEIGHT: NM

Sponsor: LASL

SITE: NTS - Area 3i
37° 02' 54" N
116° 01' 27" W
Site elevation: 4,050 ft

HEIGHT OF BURST: Surface

TYPE OF BURST AND PLACEMENT:
Surface burst - Cab on Nevada soil

CRATER DATA: NM

REMARKS:

The fallout pattern was drawn from measurements made by a scientific project and is well defined and reliable.

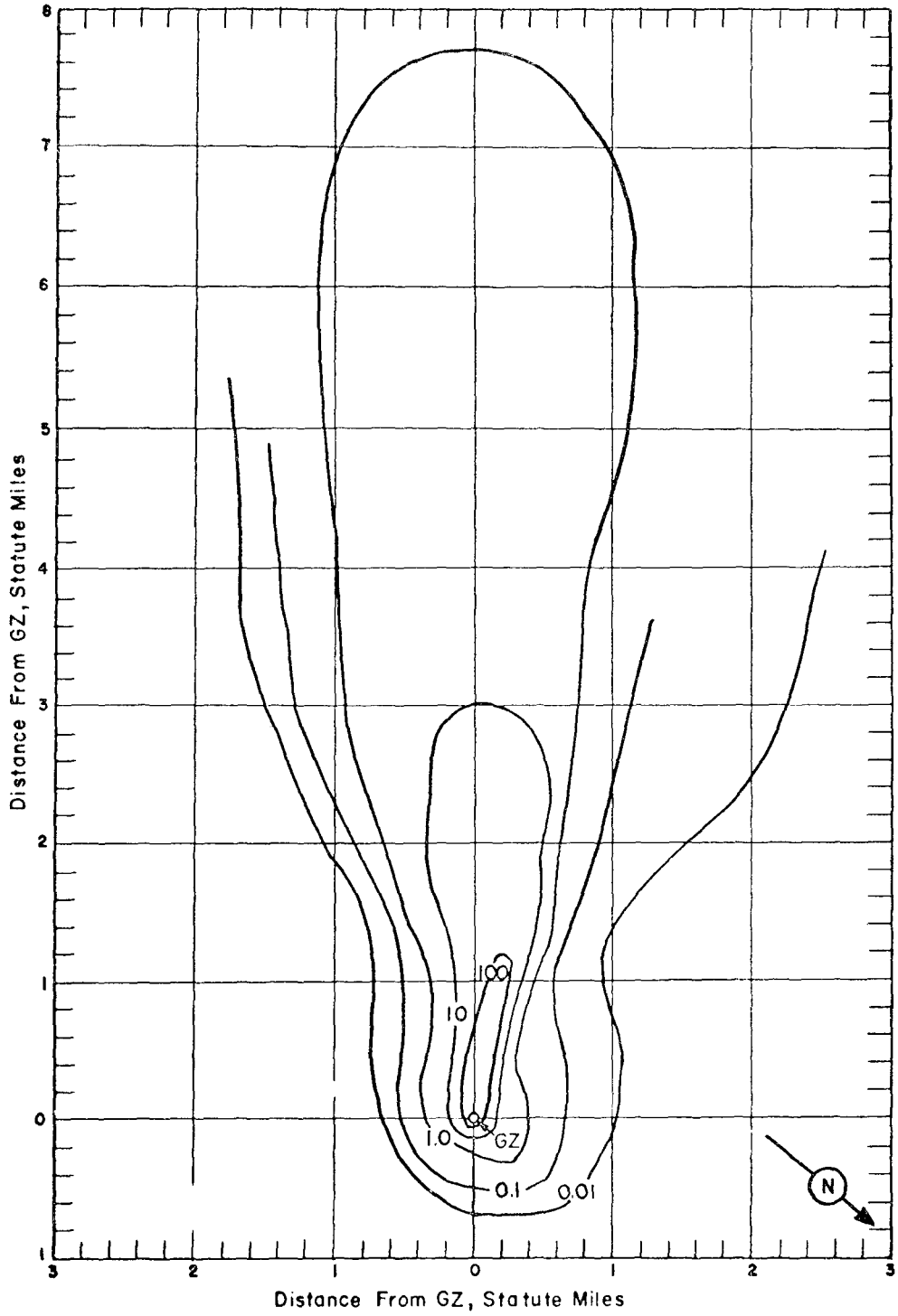

Figure 236. 58 Project - Coulomb-C.
On-site dose rate contours in r/hr at H+1 hour.

TABLE 72 NEVADA WIND DATA FOR OPERATION 58 PROJECT - COULOMB-C

Altitude (MSL)	H-hour	
	Dir	Speed
feet	degrees	mph
Surface	---	--
5,000	030	11
6,000	020	13
7,000	020	07
8,000	090	07
9,000	050	04
10,000	040	06
11,000	120	03
12,000	140	05
13,000	150	13
14,000	140	23
15,000	140	18
16,000	150	16
17,000	170	14
18,000	160	13
19,000	140	09
20,000	180	03

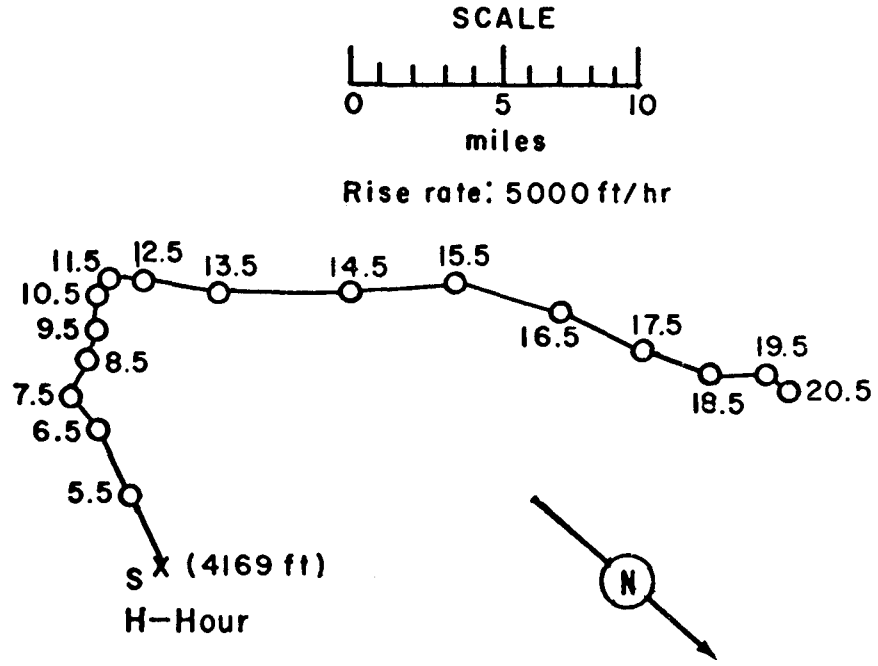

Figure 237. Hodograph for Operation 58 Project - Coulomb-C.

OPERATION HARDTACK II - Vesta Safety Experiment

	PST	GMT
DATE:	17 Oct 1958	17 Oct 1958
TIME:	1500	2300

TOTAL YIELD: 24 tons

FIREBALL DATA:
Time to 1st minimum: NM
Time to 2nd maximum: NM
Radius at 2nd maximum: NM

CRATER DATA: Not available

Sponsor: UCRL

SITE: NTS - Area 9e
37° 07' 21" N
116° 02' 05" W
Site elevation: 4,226 ft

HEIGHT OF BURST: Zero ft

TYPE OF BURST AND PLACEMENT:
Surface burst in wooden building with 20 ft of gravel over the building

CLOUD TOP HEIGHT: 10,000 ft MSL
CLOUD BOTTOM HEIGHT: NM

REMARKS:

The on-site fallout documentation was performed by the Radiological Safety Division of the Reynolds Electrical and Engineering Company for purposes of personnel safety. Readings were taken with AN/PDR-39 or Tracerlab SU-10 instruments at H+1½ hours, D+1 day and D+2 days. The pattern was well documented and should be reliable. The $t^{-1.2}$ decay approximation was used to extrapolate the dose-rate readings to H+1 hour.

The off-site fallout documentation was performed with Beckman MX-5 and AN/PDR-39 instruments by the U. S. Public Health Service for purposes of public safety. The fallout pattern is considered rather uncertain, since there were few radiation measurements. The $t^{-1.2}$ decay approximation was used to extrapolate the dose-rate readings to H+1 hour.

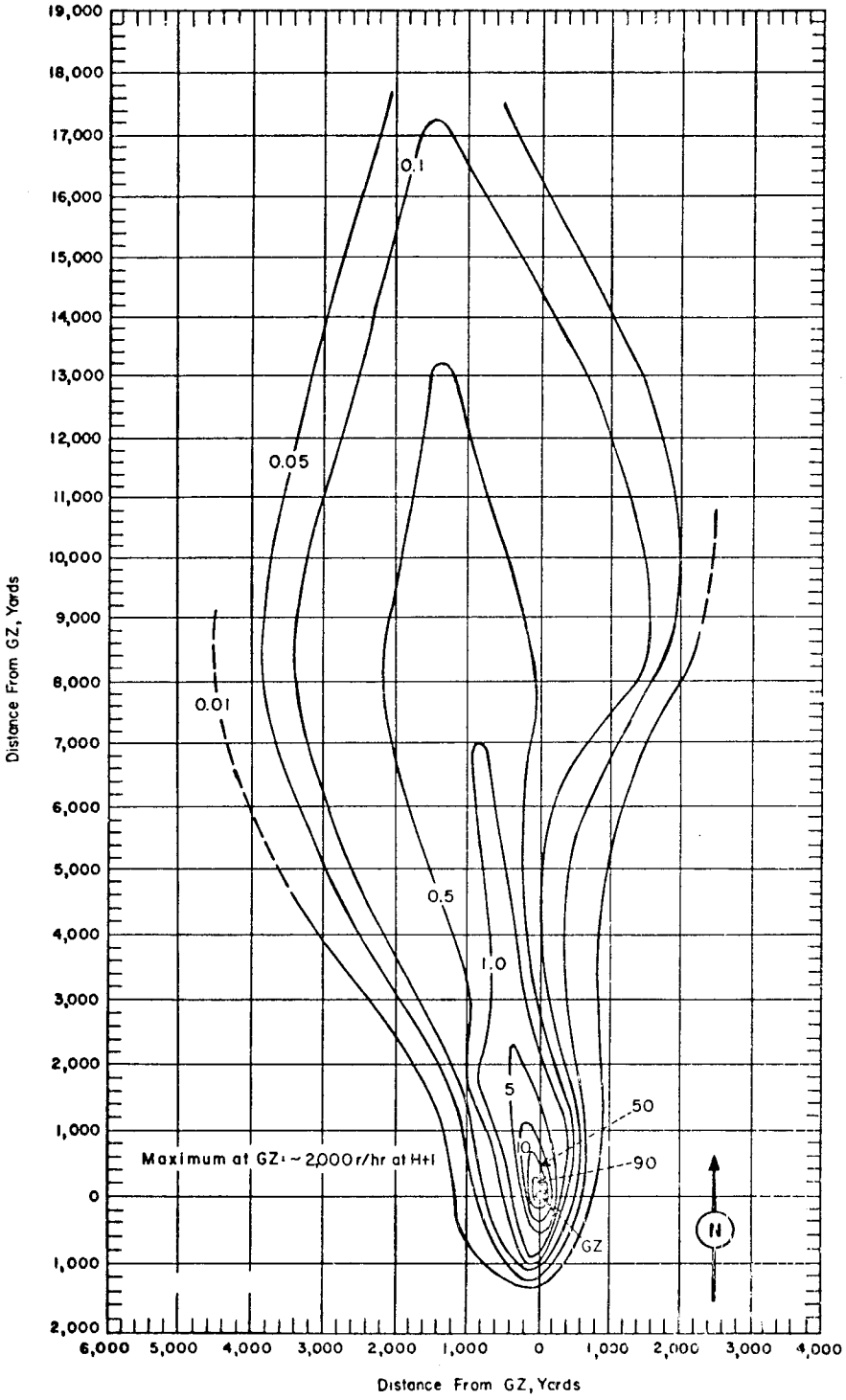

Figure 275. Operation HARDTACK II - Vesta.
On-site dose rate contours in r/hr at H+1 hour.

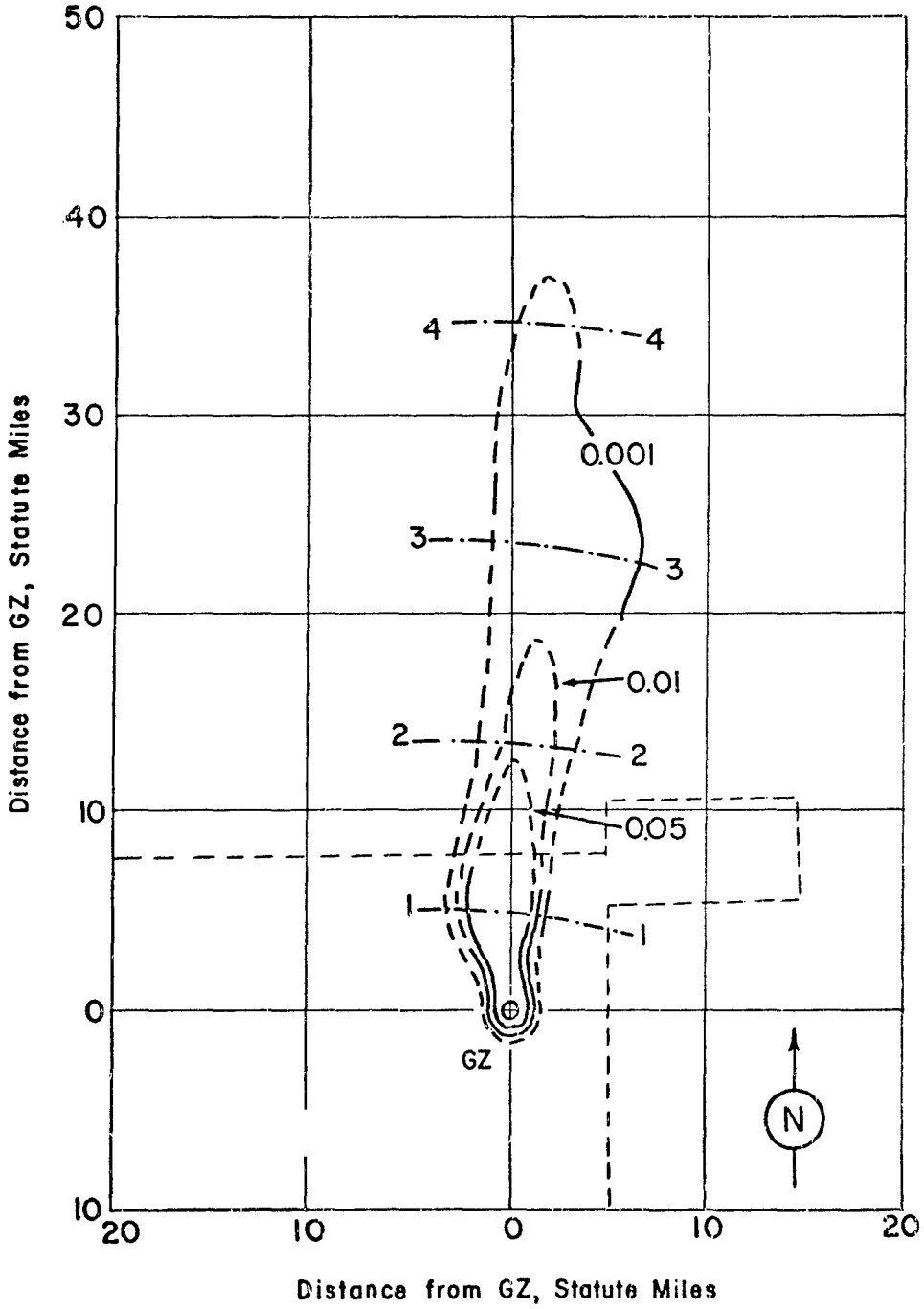

Figure 276. Operation HARDTACK II - Vesta.
Off-site dose rate contours in r/hr at H+1 hour.

TABLE 88 NEVADA WIND DATA FOR OPERATION HARDTACK II- VESTA

Altitude (MSL)	H-hour	
	Dir	Speed
feet	degrees	mph
Surface	160	07
5,000	180	12
6,000	190	14
7,000	190	14
8,000	200	12
9,000	210	10
10,000	210	08
11,000	200	09
12,000	180	07

NOTE: Wind data was obtained from the Yucca weather station.

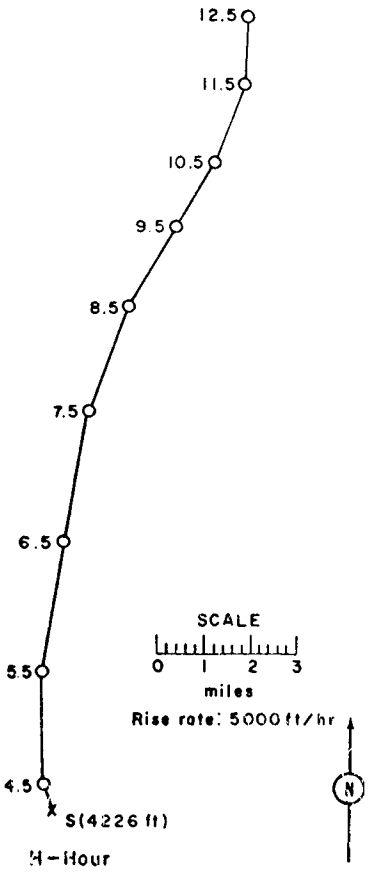

Figure 277. Hodograph for Operation HARDTACK II - Vesta

OPERATION HARDTACK II - Rio Arriba

	PST	GMT
DATE:	18 Oct 1958	18 Oct 1958
TIME:	0625	1425

TOTAL YIELD: 90 tons

FIREBALL DATA:
Time to 1st minimum: NM
Time to 2nd maximum: NM
Radius at 2nd maximum: NM

CRATER DATA: Not available

Sponsor: LASL

SITE: NTS - Area 3s
37° 02' 28" N
116° 01' 33" W
Site elevation: 4,010 ft

HEIGHT OF BURST: 72.5 ft

TYPE OF BURST AND PLACEMENT:
Tower burst over Nevada soil

CLOUD TOP HEIGHT: 13,500 ft MSL
CLOUD BOTTOM HEIGHT: 11,000 ft MSL

REMARKS:

The on-site fallout documentation was performed by the Radiological Safety Division of the Reynolds Electrical and Engineering Company for purposes of personnel safety. Readings were taken with AN/PDR-39 or Tracerlab SU-10 instruments at H+1 hour, H+6 hours, D+1 day, D+2 days and D+3 days along eight radial roads. The fallout was well documented and the pattern presented is considered to be reliable. The $t^{-1.2}$ decay approximation was used to extrapolate the dose-rate readings to H+1 hour.

The off-site fallout documentation was performed with Beckman MX-5 and AN/PDR-39 instruments by the U. S. Public Health Service for purposes of public safety. Readings were taken at about 10-mile intervals except in populated places or when the dose-rate varied considerably with distance. The downwind extent of the 0.002 and 0.001 r/hr isodose rate lines is uncertain. The rest of the pattern was well documented and is reliable. The $t^{-1.2}$ decay approximation was used to extrapolate the dose-rate readings to H+1 hour.

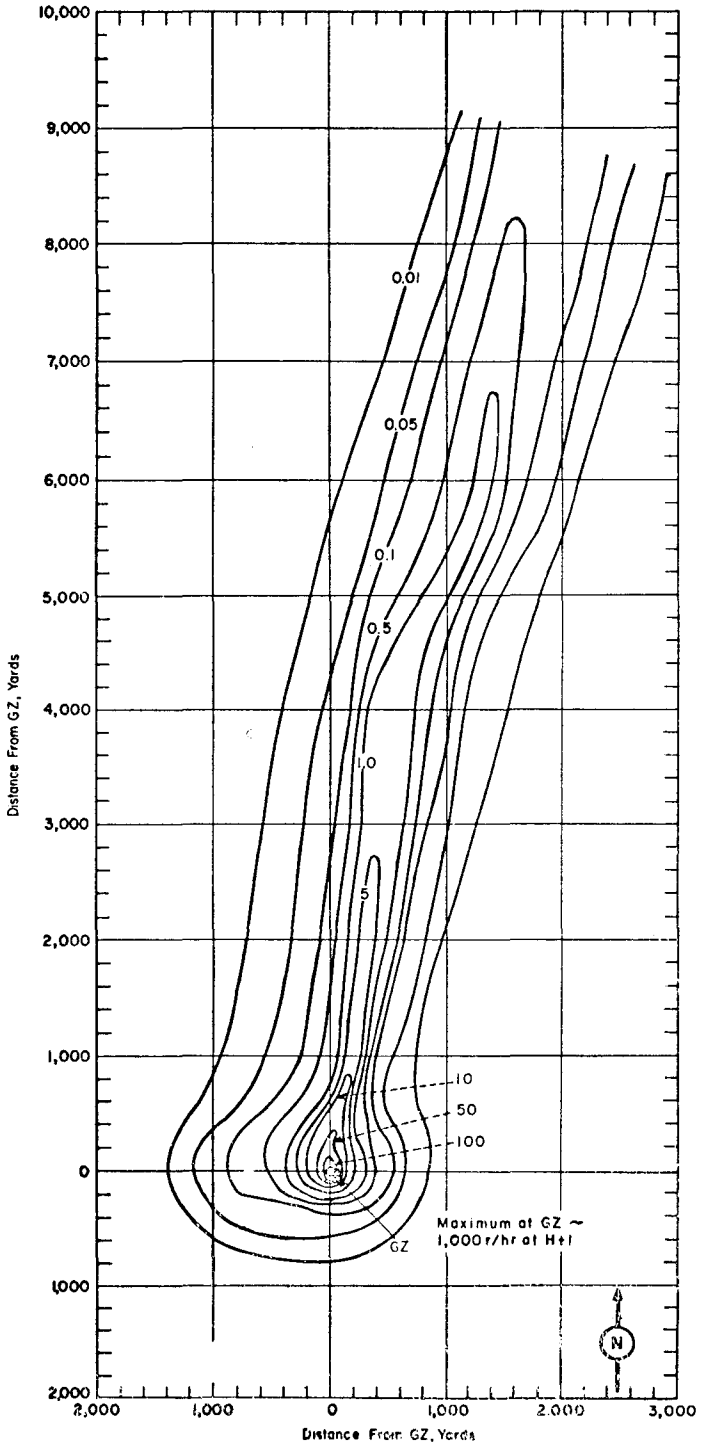

Figure 278. Operation HARDTACK II - Rio Arriba.
On-site dose rate contours in r/hr at H+1 hour.

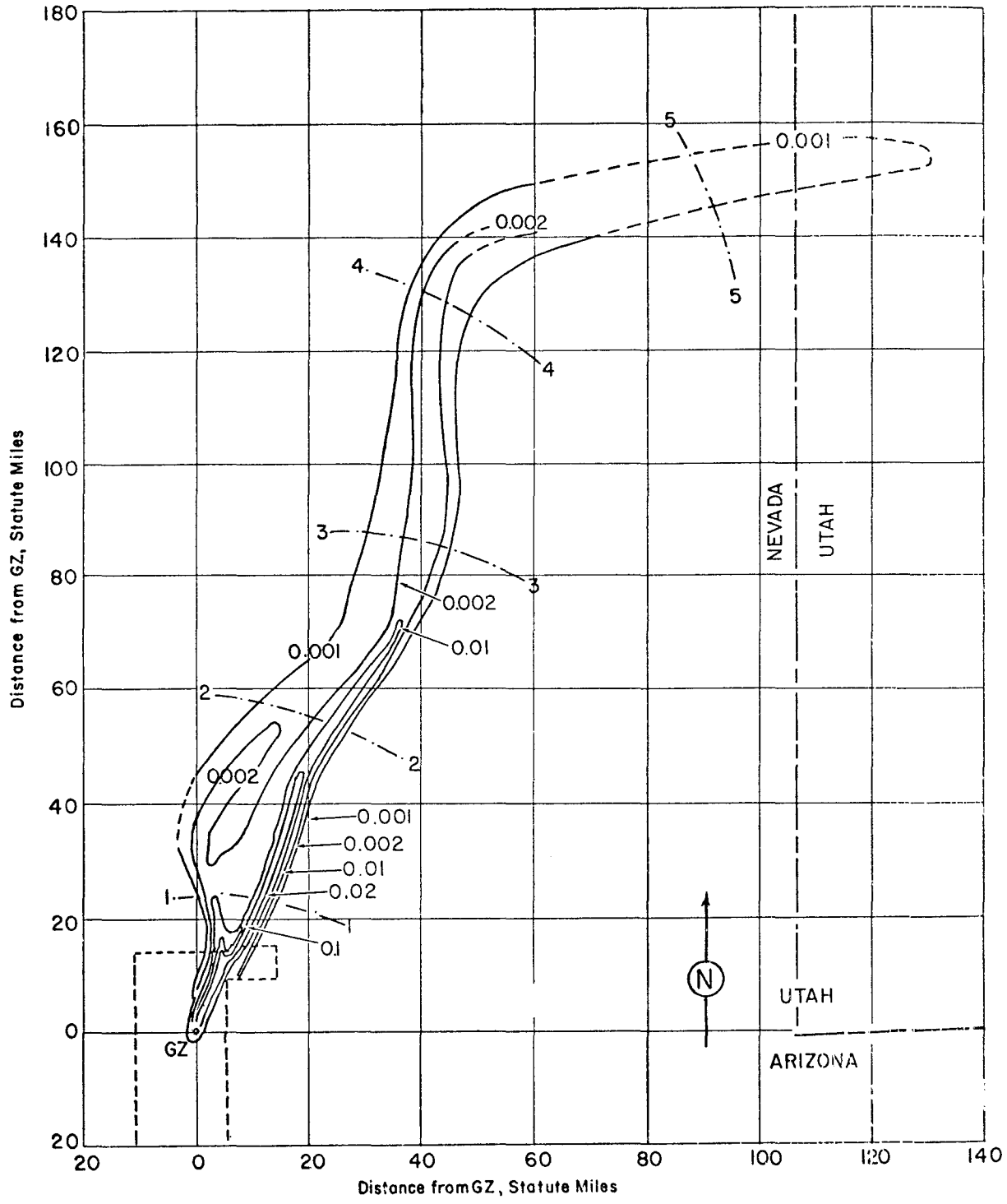

Figure 279. Operation HARDTACK II - Rio Arriba.
Off-site dose rate contours in r/hr at H+1 hour.

TABLE 89 NEVADA WIND DATA FOR OPERATION HARDTACK II – RIO ARRIBA

Altitude (MSL)	H-hour	
	Dir	Speed
feet	degrees	mph
Surface	170	02
5,000	180	09
6,000	200	24
7,000	200	35
8,000	200	37
9,000	200	33
10,000	210	35
11,000	210	38
12,000	210	40
13,000	210	40
14,000	210	38
15,000	210	36

NOTES:

1. Wind data was obtained from the Yucca weather station.
2. The surface air pressure was 12.75 psi, the temperature 9.3°C, the dew point -10.3°C, and the relative humidity 24%.

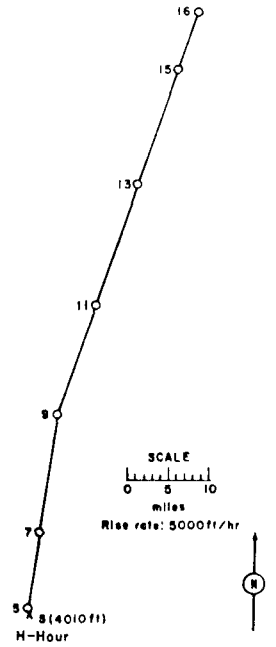

Figure 280. Hodograph for Operation HARDTACK II - Rio Arriba.

OPERATION HARDTACK II - San Juan Safety Experiment

	PST	GMT
DATE:	20 Oct 1958	20 Oct 1958
TIME:	0630	1430

Sponsor: LASL

SITE: NTS - Area 3p
37° 03' 0" N
116° 01' 56" W
Site elevation: 4,033 ft

HEIGHT OF BURST: -234 ft

TYPE OF BURST AND PLACEMENT:
Subsurface burst - Well in Nevada soil

CLOUD TOP HEIGHT: NM
CLOUD BOTTOM HEIGHT: NM

REMARKS:

"There was essentially no nuclear yield from the San Juan explosion, and no visible venting occurred. There was, however, some alpha contamination detected in the immediate vicinity of the well in which this device was detonated"

OPERATION HARDTACK II - Humboldt

	PST	GMT
DATE:	29 Oct 1958	29 Oct 1958
TIME:	0645	1445

TOTAL YIELD: 7.8 tons

FIREBALL DATA:
Time to 1st minimum: NM
Time to 2nd maximum: NM
Radius at 2nd maximum: NM

CRATER DATA: Not available

Sponsor: UCRL - DOD

SITE: NTS - Area 3v
37° 02' 52" N
116° 01' 29" W
Site elevation: 4,029 ft

HEIGHT OF BURST: 25 ft

TYPE OF BURST AND PLACEMENT:
Tower burst over Nevada soil

CLOUD TOP HEIGHT: 7,500 ft MSL
CLOUD BOTTOM HEIGHT: 6,000 ft MSL

REMARKS:

The on-site fallout documentation was severely limited by changes in the GZ location and the operational firing schedule. Readings for the very close-in pattern were taken by the Chemical Corps Radiological Safety Support Unit at points along the north, east, south, and west radial lines at times between 0.1 and 6.7 hours. Experimental dose-rate decay curves were used to extrapolate the readings to H+1 hour. Readings for the on-site fallout pattern were taken at H+$\frac{1}{2}$ hour, H+6 hours, H+27 hours and D+2 days. The $t^{-1.2}$ decay approximation was used to extrapolate the dose-rate readings to H+1 hour. "The on-site fallout from Humboldt was well documented and the pattern is considered reliable"

The off-site fallout documentation was performed with Beckman MX-5 and AN/PDR-39 instruments by the U. S. Public Health Service for purposes of public safety. The $t^{-1.2}$ decay approximation was used to extrapolate the dose-rate readings to H+1 hour. "Although there is some uncertainty in the downwind extent of some of the isolines, there is fair confidence in the width of the pattern and in the orientation of the fallout, which is consistent with the wind analysis".

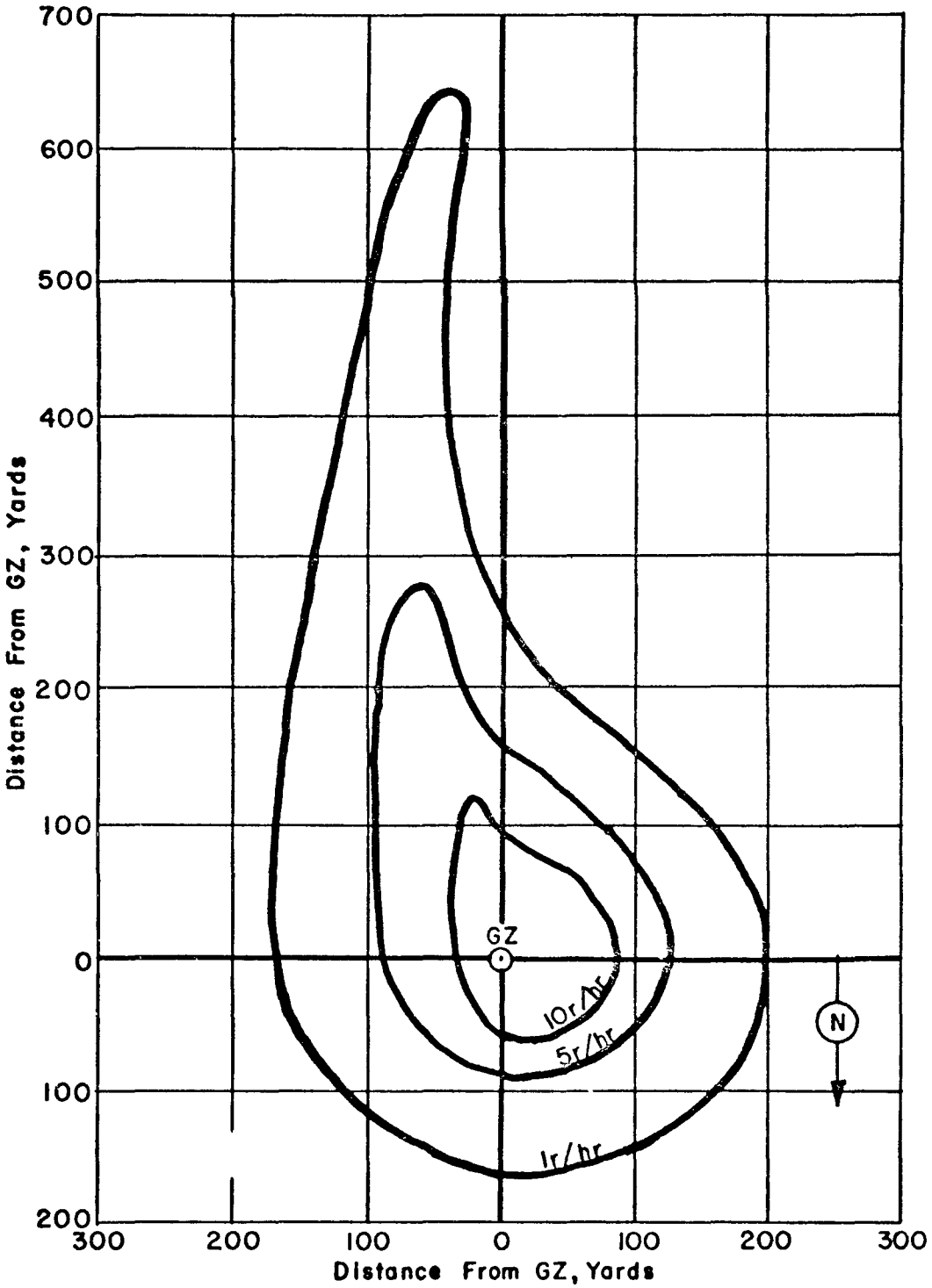

Figure 300. Operation HARDTACK II - Humboldt.
Very close-in dose rate contours in r/hr at H+1 hour.

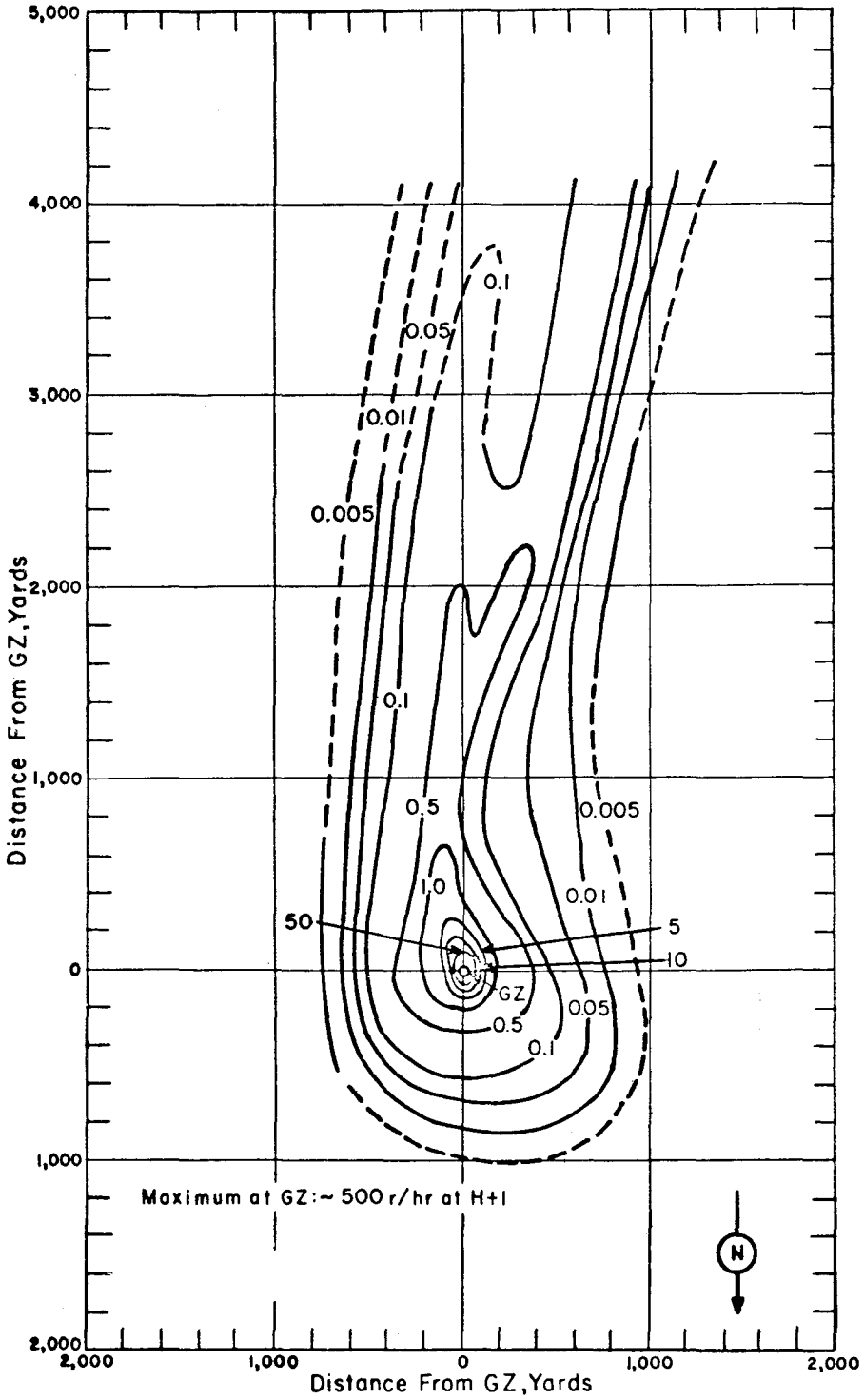

Figure 301. Operation HARDTACK II - Humboldt.
On-site dose rate contours in r/hr at H+1 hour.

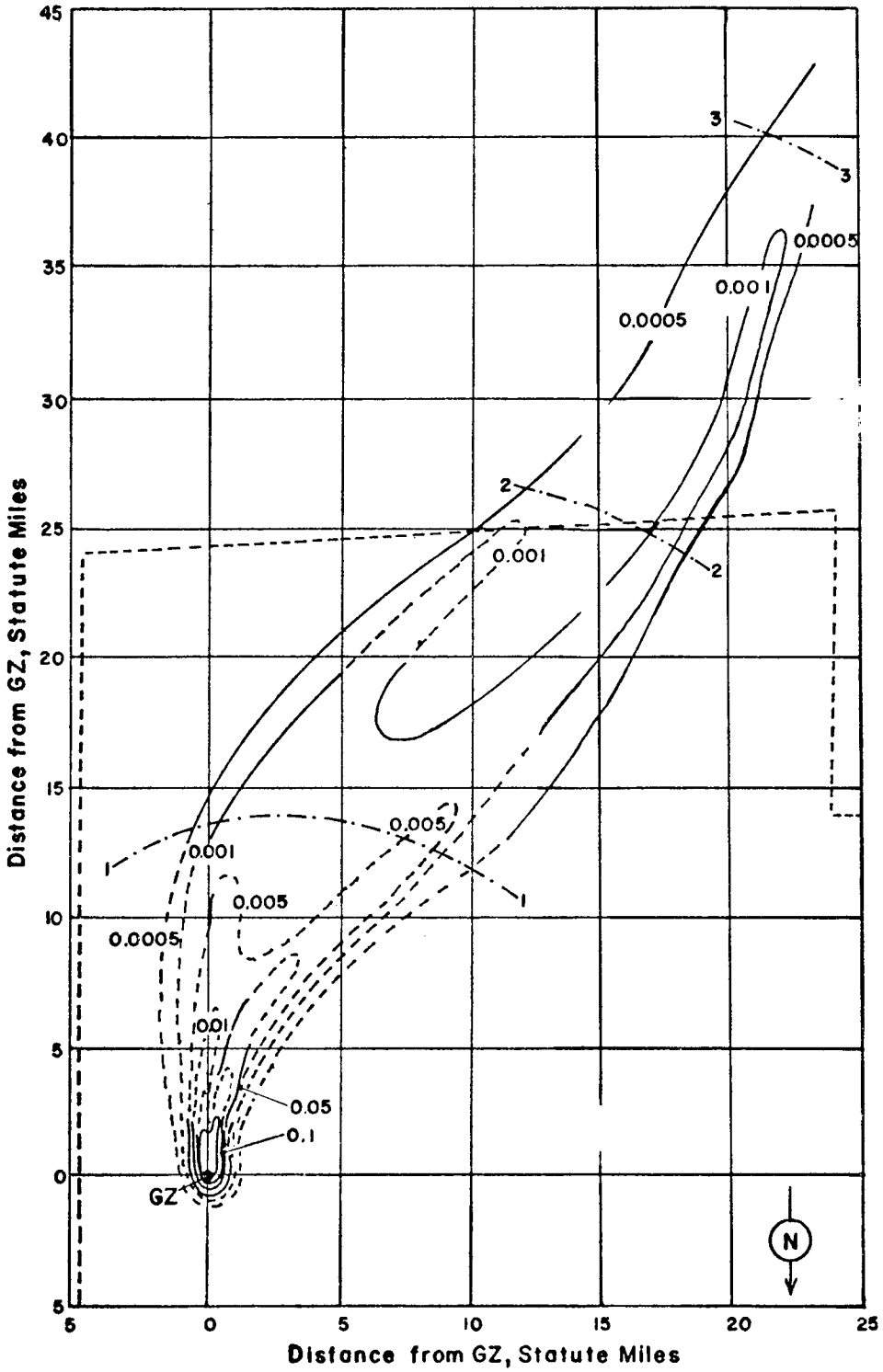

Figure 302. Operation HARDTACK II - Humboldt.
Off-site dose rate contours in r/hr at H+1 hour.

TABLE 100 NEVADA WIND DATA FOR OPERATION HARDTACK II - HUMBOLDT

Altitude (MSL)	H-hour	
	Dir	Speed
feet	degrees	mph
Surface	340	07
5,000	010	29
6,000	020	30
7,000	030	37
8,000	030	33
9,000	030	22
10,000	040	16

NOTES:

1. Wind data was obtained from the Yucca weather station.
2. The surface air pressure was 12.84 psi, the temperature 7.4°C, the dew point -3.2°C, and the relative humidity 46%.

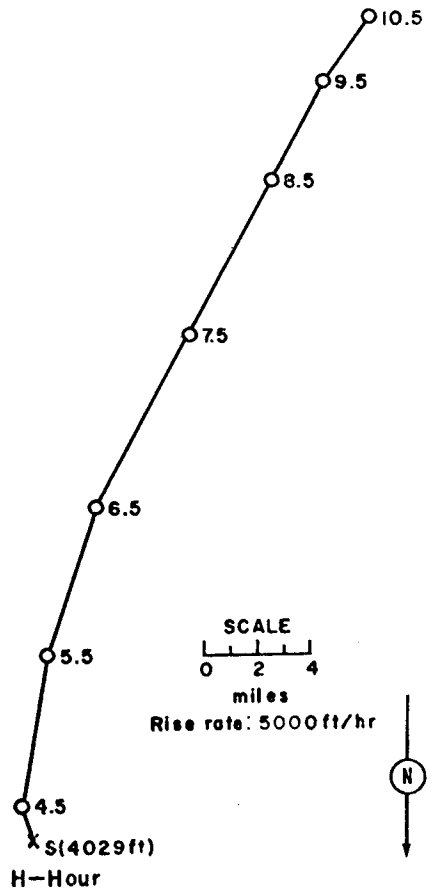

Figure 303. Hodograph for Operation HARDTACK II - Humboldt

OPERATION SUNBEAM - Small Boy

	PST	GMT
DATE:	14 Jul 1962	14 Jul 1962
TIME:	1030	1830

SPONSOR: DOD

SITE: NTS - Area 5
36° 48' 08.9942" N
115° 55' 89.2031" W

SITE ELEVATION: 3078 ft MSL

HEIGHT OF BURST:

TYPE OF BURST AND PLACEMENT:
Tower, over Nevada soil

CLOUD TOP HEIGHT: 19,000 ft MSL

REMARKS:

The close-in and distant contours of residual radiation are shown in Figures 329 thru 332 The estimated Small Boy GZ contours of Figure 329 are based on data taken from D-day to D+3 days by NDL, NRDL, and REECo. The composite decay curve of NDL Project 2.8 was used to correct the data to H+1 hour. The close-in contours of Figure 330 are revisions of those with data from NRDL Project 2.11 included and supplemented by data from the REECo Rad Safe Group and NDL Project 2.9.

The two off-site contour patterns are shown in Figure 331 (out to 29 miles) and Figure 332 (out to 300 miles). The middle portion of Figure 331 (around 15 miles downwind) was constructed using data from NDL, UCLA, NRDL, and the PHS. The portion farthest downwind was constructed from data obtained by NDL and UCLA. The contours were corrected to H+1 hour using a decay constant of 1.27. Figure 332 is based almost entirely on ground monitor surveys conducted by NDL, UCLA, and the PHS, supplemented by aerial surveys by CETO Project 62.80. The data were extrapolated back to H+1 hour by $t^{-1.2}$. The fallout started arriving at 250 to 400 miles downwind sometime in the latter part of D+1 day reaching a peak at D+2 days. Figure 333 shows the probable path of the Small Boy cloud as determined by exposure rate measurements as far as western Nebraska.

In all the figures the dashed portions indicate uncertainty.

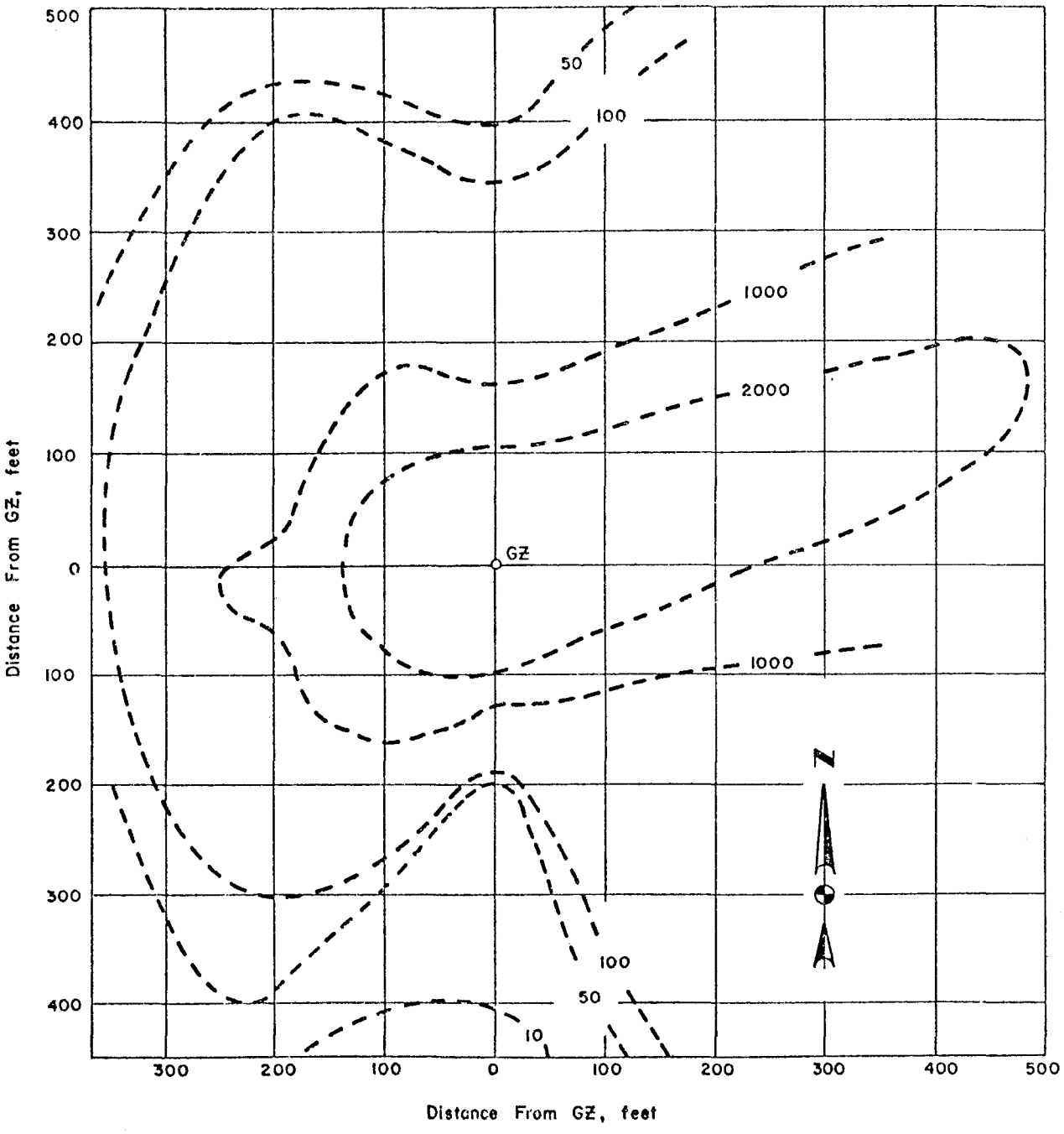

Figure 329. OPERATION SUNBEAM - Small Boy GZ area
contours in R/hr at H+1 hour

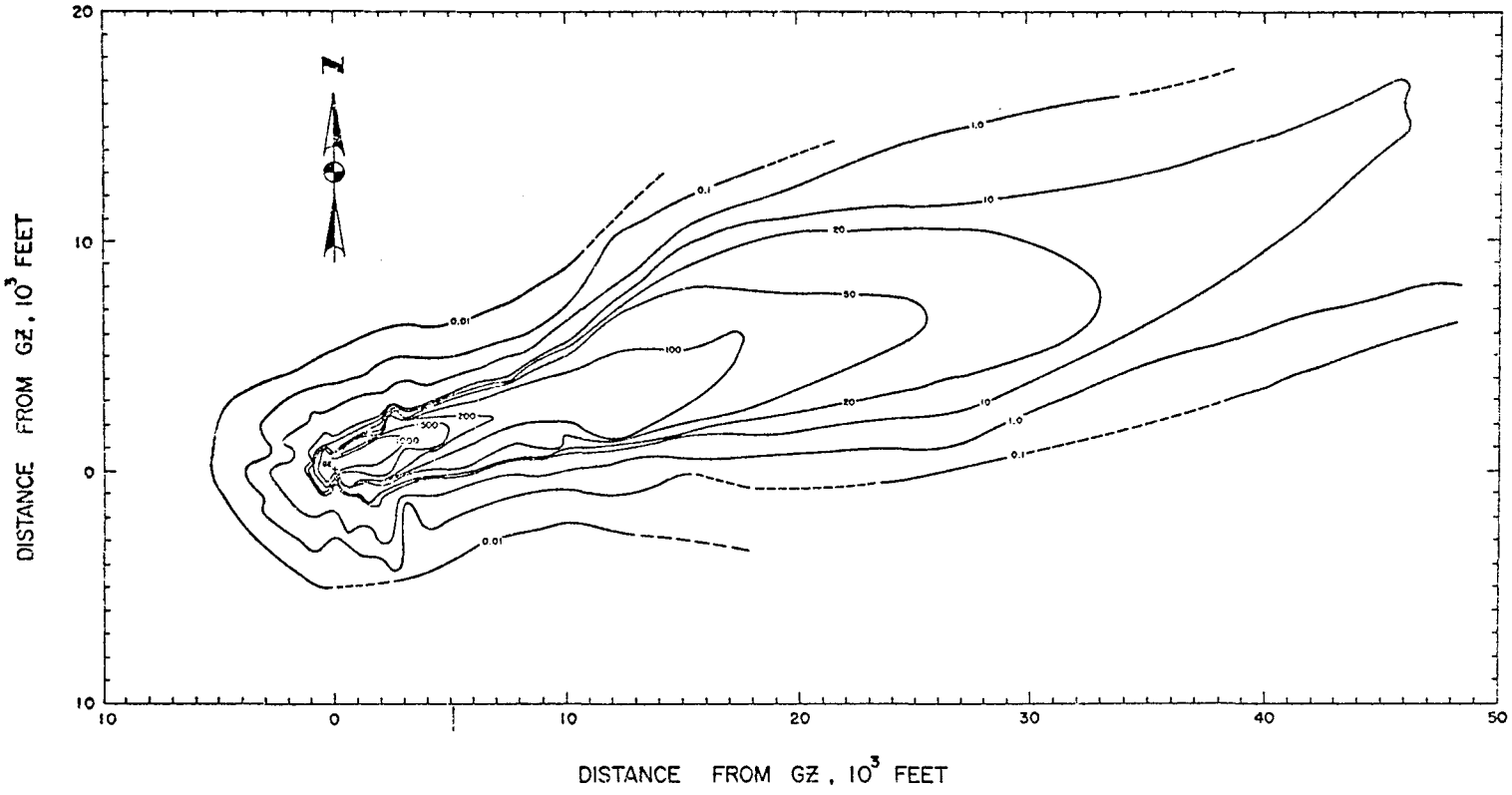

Figure 330. OPERATION SUNBEAM - Small Boy contours of residual gamma radiation in R/hr at H+1 hour to 50,000 feet downwind

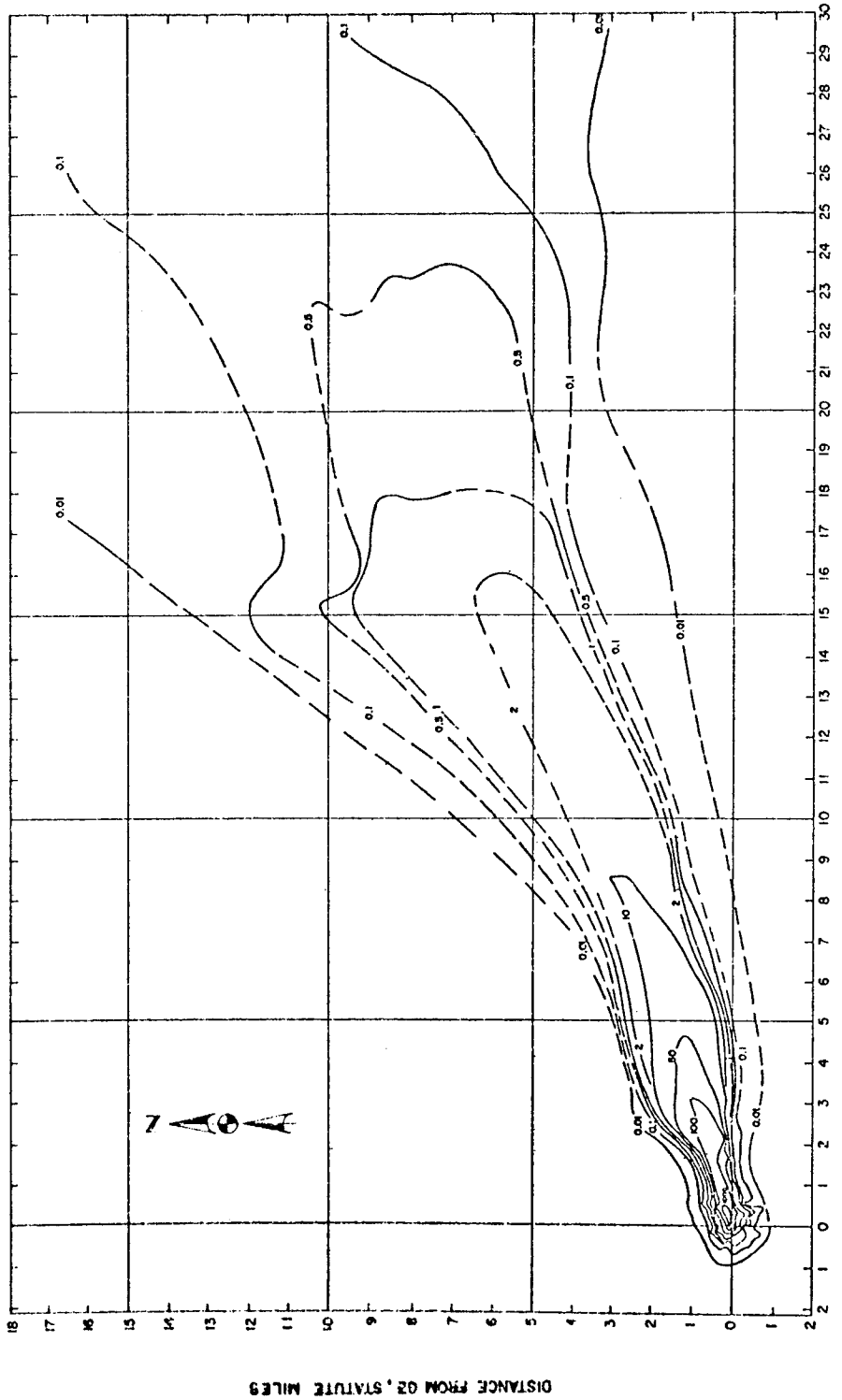

Figure 331. OPERATION SUNBEAM - Small Boy contours of residual gamma radiation in R/hr at H+1 hour to 29 miles downwind

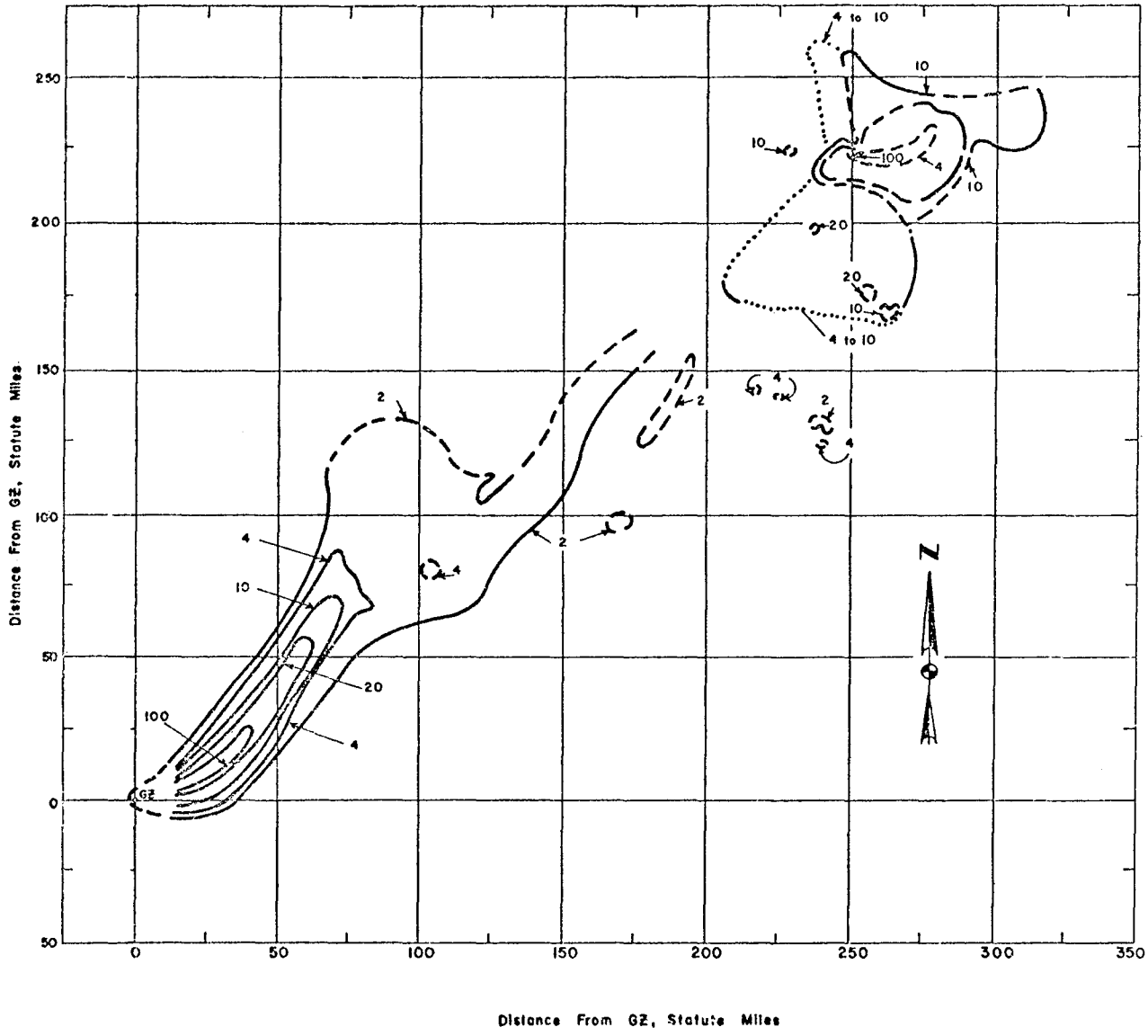

Figure 332. OPERATION SUNBEAM - Small Boy contours of residual gamma radiation in R/hr at H+1 hour to 300 miles downwind

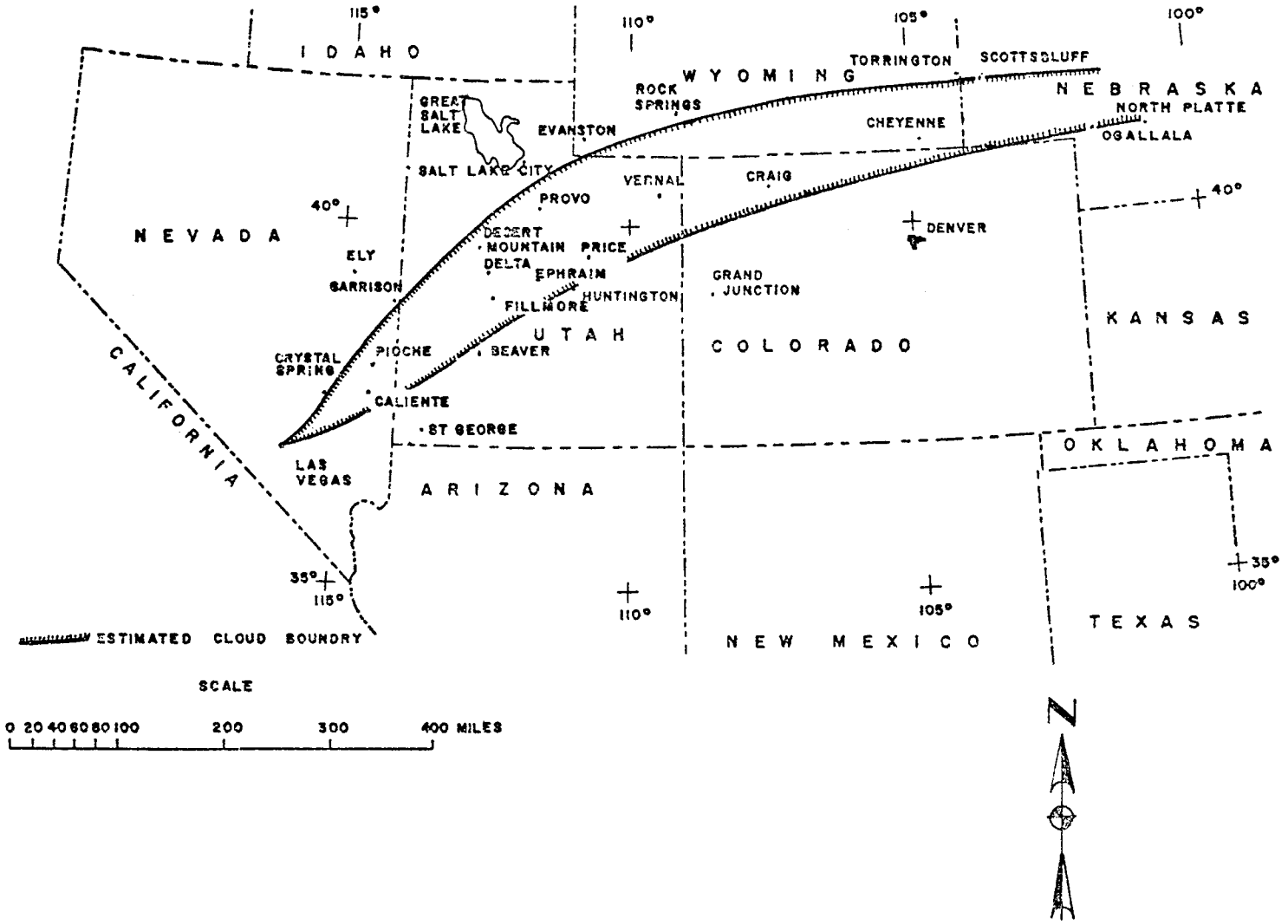

Figure 333. OPERATION SUNBEAM - Small Boy cloud path

TABLE 109 NEVADA WIND DATA FOR OPERATION SUNBEAM - SMALL BOY

Altitude (MSL)	H+5 Minutes		H+1/4 Hour		H+70 Minutes	
	Direction	Speed	Direction	Speed	Direction	Speed
feet	degrees	mph	degrees	mph	degrees	mph
3,078	135	2.3	120	12.3	180	6.9
4,000	300	1.2	145	4.6	185	6.9
5,000	310	1.2	170	5.8	188	8.1
6,000	330	2.3	180	6.9	212	9.2
7,000	280	2.3	170	6.9	224	11.5
8,000	250	6.9	180	3.5	237	11.5
9,000	240	13.8	230	5.8	245	12.7
10,000	240	18.4	240	12.7	240	15.0
12,000	240	9.2	235	10.4	225	9.2
14,000	240	9.2	230	9.2	280	8.1
15,000	-	-	-	-	265	4.6
16,000	240	9.2	230	8.1		
18,000	280	16.1	260	15.0		
20,000	280	28.8	280	26.5		

Notes:

1. Observations made at Frenchman's Flat.

2. Air temperature at the surface was 31.7°C; the relative humidity was 16%.

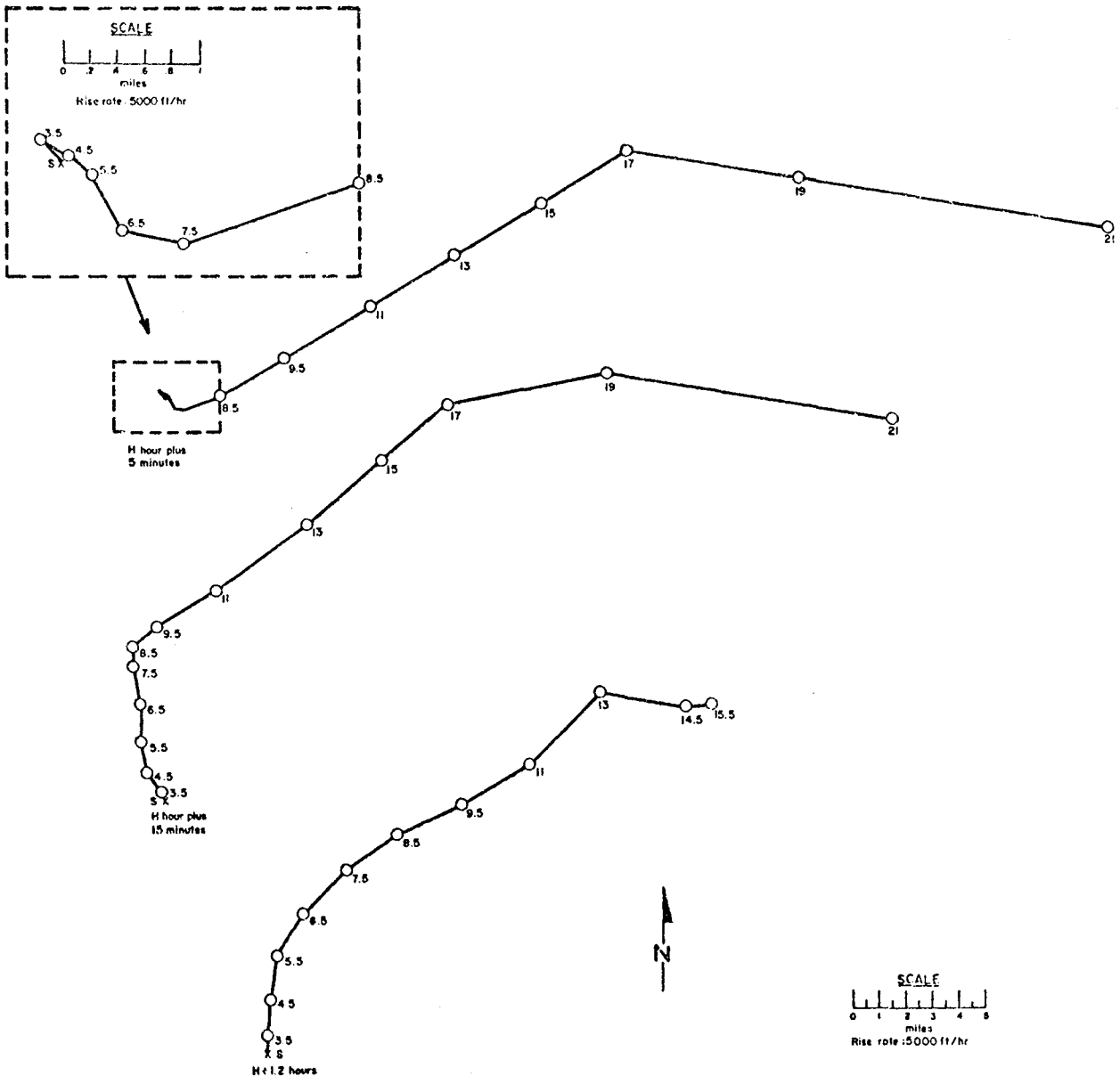

Figure 334. Hodograph for OPERATION SUNBEAM - Small Boy.

OPERATION SUNBEAM - Little Feller I

	PST	GMT
DATE:	17 Jul 1962	17 Jul 1962
TIME:	0900	1700

SPONSOR: DOD

SITE: NTS - Area 18
37° 06' 30.7784" N
116° 19' 02.1775" W

SITE ELEVATION: 5194 ft MSL

HEIGHT OF BURST:

TYPE OF BURST AND PLACEMENT: Near surface, over Nevada soil. Warhead fired from Davy Crockett weapon system.

CLOUD TOP HEIGHT: 11,000 ft MSL

REMARKS:

The close-in and distant contours of residual radiation are shown in Figures 335 thru 338. The very close-in contours are shown in Figure 335 Figure 337 shows contours of residual gamma radiation at H+4 hours to 12,000 feet downwind. The earliest readings were not taken until approximately H+4 hours because troop exercises were executed in the area of interest at earlier times. The application of an average decay exponent to the overall pattern or representative portions of the pattern did not appear to be justified; therefore the H+4-hour patterns are presented as the basic patterns and are considered reliable. The H+4-hour patterns were constructed from data obtained by NDL, REECo Rad Safe Group remote units, and PHS off-site surveys. Figures 336 and 338 are the result of arbitrarily applying a decay exponent of 1.2 to produce H+1-hour patterns. These patterns are given only to represent the order of magnitude of the H+1-hour dose rates and are considered to be much less reliable than the ones representing H+4 hours.

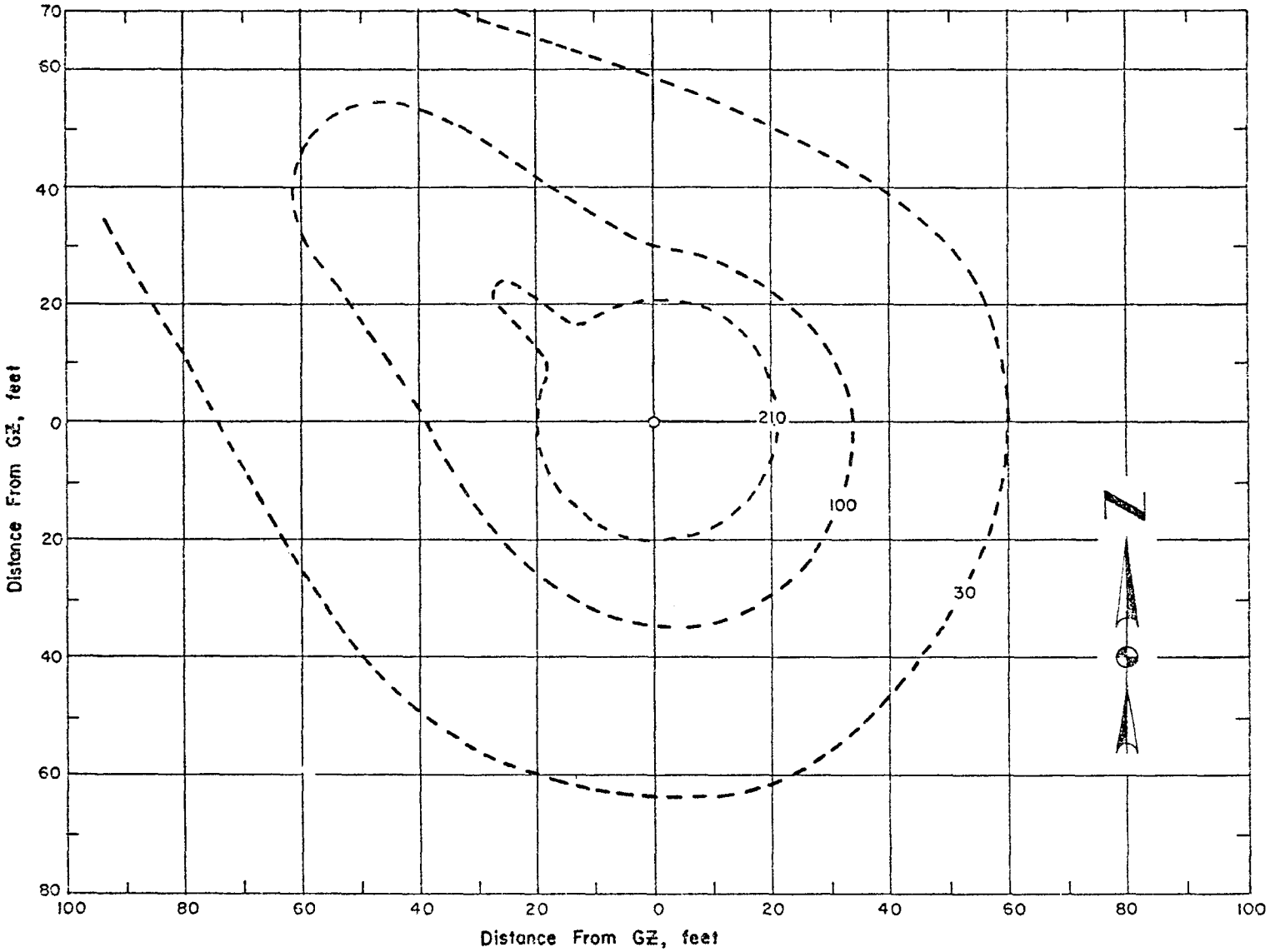

Figure 335. OPERATION SUNBEAM - Little Feller I contours of residual gamma radiation in R/hr at H+4 hours to 70 feet downwind.

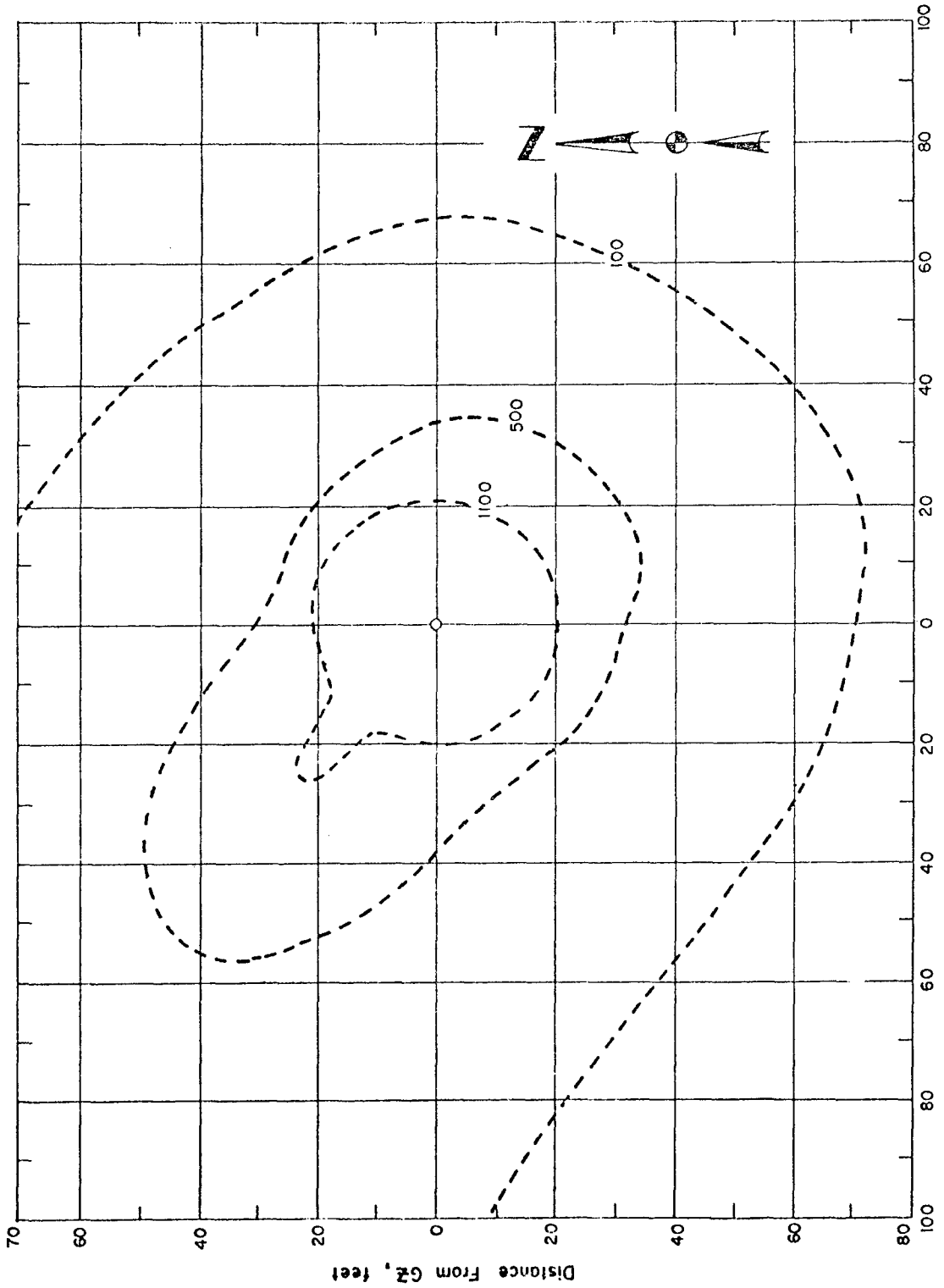

Figure 336. OPERATION SUNBEAM - Little Feller I contours of residual gamma radiation in R/hr at H+1 hour to 70 feet.

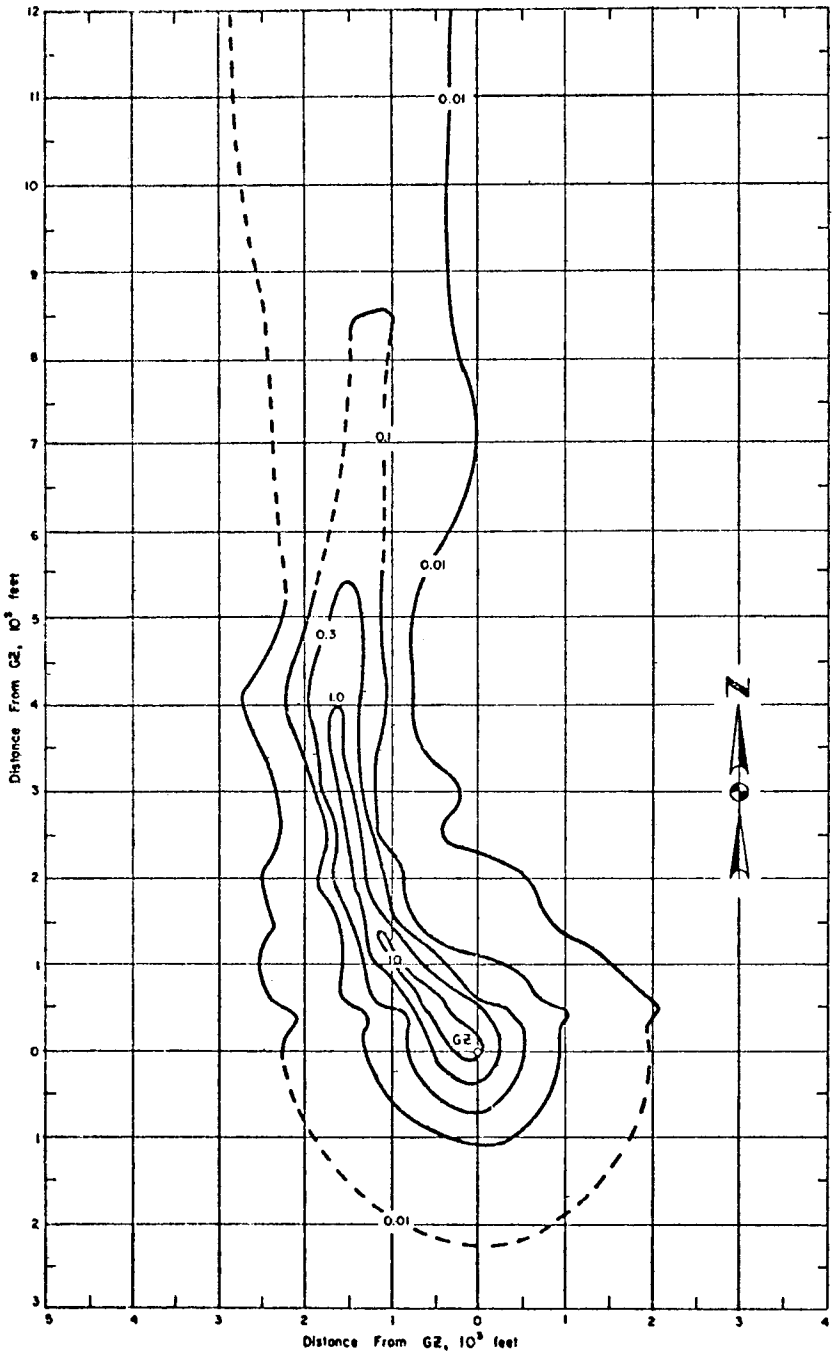

Figure 337. OPERATION SUNBEAM - Little Feller I contours of residual gamma radiation in R/hr at H+4 hours to 12,000 feet downwind.

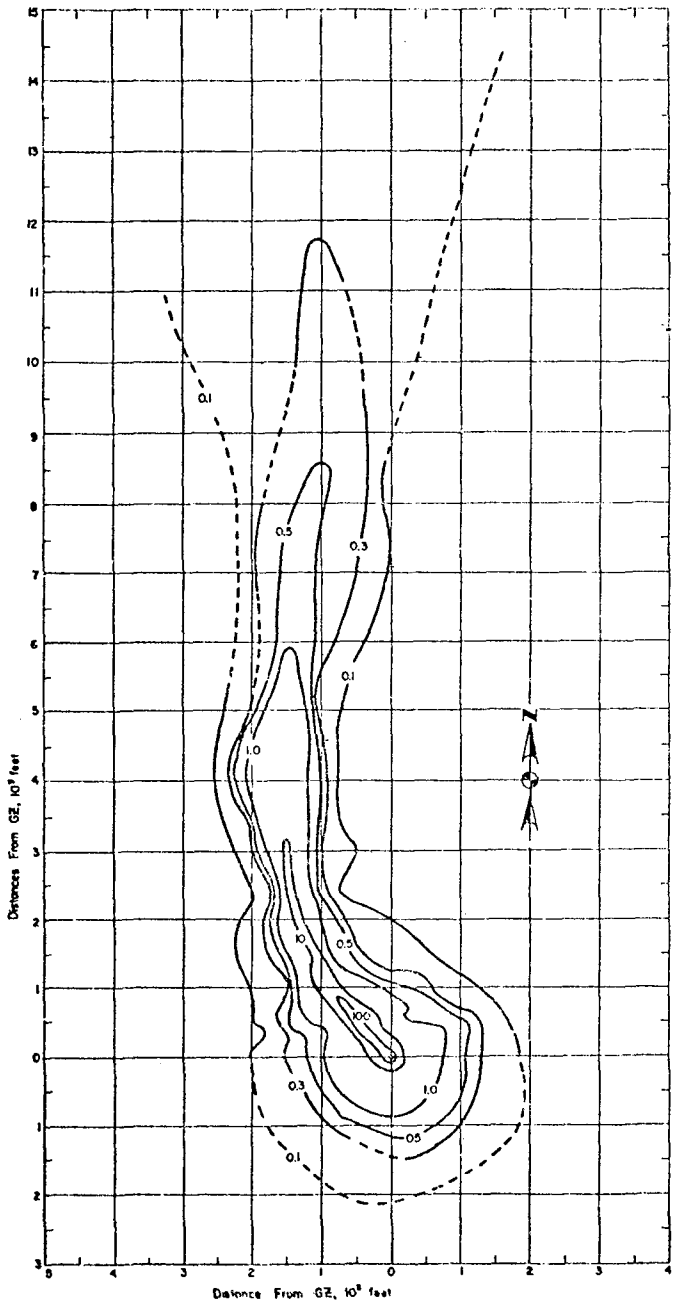

Figure 338. OPERATION SUNBEAM - Little Feller I contours of residual gamma radiation in R/hr at H+1 hour to 12,000 feet downwind.

TABLE 110 NEVADA WIND DATA FOR OPERATION SUNBEAM - LITTLE FELLER I

Altitude (MSL)	H-Hour	
	Direction	Speed
feet	degrees	mph
Surface	200	17.3
6,000	200	15.0
7,000	190	13.8
8,000	170	13.8
9,000	170	12.7
10,000	150	12.7
11,000	140	12.7
12,000	150	15.0
13,000	180	17.3
14,000	180	23.0
15,000	180	26.5
16,000	190	28.8

Notes:

1. Observations made at forward control point, Area 18.

2. Air temperature at the surface was 29.7°C and the relative humidity was 17 percent.

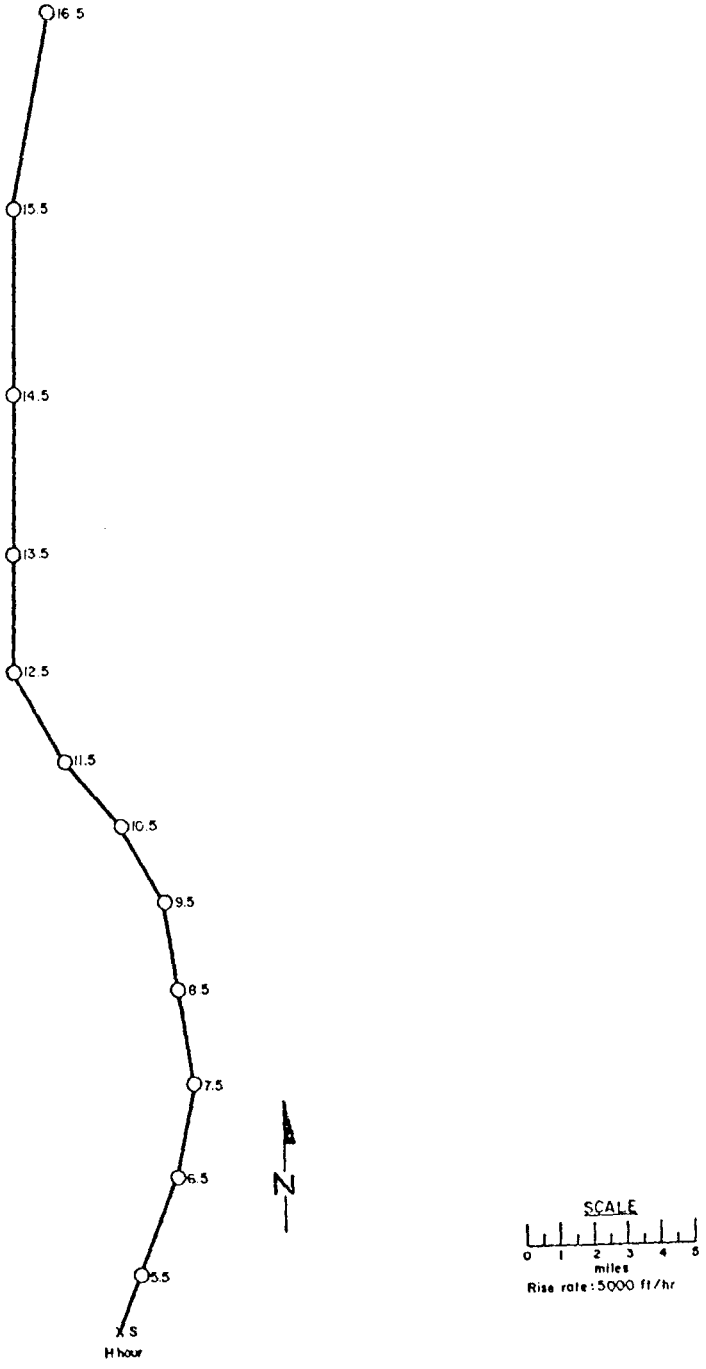

Figure 339. Hodograph for OPERATION SUNBEAM - Little Feller I.